POWER

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ELY C. HUTCHINSON, *Editor*

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John Fitch

ON THE twenty-first of January, 187 years before the date of this issue, John Fitch was born at Windsor, Conn.

Ask the first thousand men you meet who invented the steamboat and the overwhelming majority of them will tell you "Robert Fulton."

But John Fitch commenced working upon the problem in 1785, when Fulton was twenty years old, eight years before he conceived the idea of propelling vessels by steam and fifteen years or more before he did anything about it.

At this time Fitch, whose first idea was of a steam wagon, given up for what appeared to be the more feasible plan of a boat propelled by steam, was much chagrined by being shown a book with a description of Watt's engine in it. He averred that he had never heard of a steam engine and supposed himself to be its inventor as well as the first to apply it to marine propulsion.

This, if true, is a striking illustration of the slowness of communication and dissemination of knowledge in those times. Watt's engine was in fairly common use in England, and there were Newcomen engines in this country.

But Fitch was not the only one with the idea. Donaldson claimed to have invented a steamboat and was about to apply to the State of Pennsylvania for the exclusive right to use it. Fitch got there first and was granted rights in New Jersey, Pennsylvania and Delaware. This was because he was working on the Delaware River.

Still another, a Virginian, James Rumsey by name, was given similar exclusive rights in steam navigation in Virginia, Maryland and New York. Even Ben Franklin proposed to run boats by steam, but his idea was to pump the water from the front and discharge it under pressure over the stern. And then there was Stevens.

In 1787 Fitch tried out a boat in the presence of many members of the convention that was framing the Federal Constitution. By 1790 he had a larger boat that covered some two thousand miles, sometimes at nine or ten miles an hour.

Fulton was unable to beat this record with the Claremont seventeen years later.

Fitch later made a small boat with a screw propeller. He seems to have had vision and ingenuity but to have lacked business capacity. His whole life was one of constantly recurring disappointment and failure, ending with suicide at the age of fifty-five.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

Keeping Down Investment Costs

FOR SEVERAL YEARS PAST the goal of central station designers has been utilization of as much as possible of the heat in fuel. Regardless of the fact that in some instances it partook of professional rivalry, with too little regard to local conditions, the results attained stand as a monument to the skill of the designers. But the law of diminishing returns has intervened and it is not likely, with present cycles, that thermal efficiency will be much more improved.

It is charged, with some justification, that present performance has been attained at a sacrifice of operating simplicity and at increased investment cost. While there is no denying the complication involved, it is to the credit of both plant and equipment designers that unit investment cost has increased but slightly. Large-capacity units have contributed to this result.

Nevertheless, there must be further progress, and the present urge is in the direction of lower investment cost and increased commercial efficiency without sacrifice of thermal efficiency. There are many ways in which this may be accomplished, as pointed out elsewhere in this number by W. S. Johnston. Some of his suggestions may startle those accustomed to the old order, but as representing advanced thinking upon this very important subject they deserve careful consideration. *Power* welcomes any discussion Mr. Johnston's ideas may suggest.

The Law And the Profits

THE FIRST TWO of *Power's* primary principles are "Making Power When it Should Be Made" and "Buying Power When it Should Be Bought." In these are the economic law and the profits. Nothing would be more distressing than a public utility sales policy which sought to market its power at the expense of economy to the user.

Time was when arguments in favor of the purchase of power were as flagrant as the imagination of the contracting agent. Happily those days are, in most cases, gone forever and in their place have come an intelligent interpretation of the purchaser's power requirements and a genuine effort to help him find the cheapest power rate on the schedule. Sound growth of the utility's power service is the result.

The industrial operator has likewise to determine, by basic reasoning, whether it is better to purchase power from a utility or neighboring industry than to generate it with a plant of his own. He must take careful account of capital cost, obsolescence, maintenance, reliability, operating charges and the individual factors applying to the particular case under consideration. He should seek the advice of a reliable consultant to audit his findings or recommend procedure after independent study.

Where a sufficient saving over the cost of purchased power is shown, the industrial plant should be built, specious arguments to the contrary notwithstanding.

Conversely, no amount of persuasion should cause an industrial plant to be built in the face of adverse economic facts.

The public utilities and the industrial power plants have their places. There will be no doubt as to where, if all queries are answered according to the inexorable law of economics. The profits will then take care of themselves.

Safeguarding Building Services

FIRE has revealed the vulnerable spots in many supposedly safe designs. What happened recently at the Marguery Apartments, New York City, again emphasizes the need for safeguarding the power supply and other services in large buildings. The fire started in a second-basement furniture store. Although it did not get beyond that floor, the building power feeders were destroyed and the gas lines were broken. When the power was interrupted an elevator stopped between two floors. An explosion, of mysterious origin, apparently blew out the second-basement hoistway doors, allowing smoke to reach the elevator, killing the operator. Failure of the power supply left the building without elevator and other services for about fifteen hours.

The fact that the fire, destructive as it was, did no damage except on the floor where it started, indicates that the building is substantially fireproof. Making buildings fireproof is not sufficient to prevent serious destruction from fires. Materials stored in them may provide fuel for a devastating blaze. Automatic fire-extinguishing systems are probably the best means of preventing serious fires where inflammable materials are stored.

Interrupting the power supply to a building during a fire is one of the most serious things that can occur, and every effort should be made to guard against this possibility. Not only elevator, but also water supply and other important services fail when the power is disconnected. If power is taken from an outside source it should be brought in by two independent feeder systems on opposite sides of the building. If this cannot be done a second source of power should be provided in the

building. Oil-engine generating units have much to recommend them for this purpose. They occupy small space and can quickly be put into operation.

No matter how the reliability of the power supply is assured, the distribution system must also be protected. To have the electrical distribution system out of service for several hours should not be tolerated. Although the loss of life in the Marguery was small, it is obvious that in a large building left in darkness and without elevator service during a fire a panic might easily occur. To safeguard life should be the first objective in building design and operation. Failure to do so is little short of criminal.

Elevator Rope Construction

WHAT is known as a six-nineteen rope construction has been used extensively for elevator service. The tendency of this type of construction to fail because of the wire breaking has led some engineers to adopt a more flexible type, such as the six-thirty-seven or the eight-nineteen. The results reported from the use of these ropes indicate considerably longer life than with the less flexible type. Notwithstanding this, some of the outstanding elevator rope mileage records have been made with the six-nineteen construction. Methods for judging the life of wire rope are far from satisfactory and comparisons are difficult to make. Consequently, any conclusion drawn from the ordinary field experience should be weighed carefully. Nevertheless, the chief cause of wire rope failure is the breaking of the wires. If this can be overcome, increased life may be expected.

If fatigue due to bending were the only cause of breakage, it might be removed by increasing the flexibility of the rope through the use of smaller wires. When ropes on a traction elevator slip in the sheave the wires in contact with the groove must take the load that produced slippage. If the outside wires in the strands are small, the stresses set up in them due to slipping may cause failure, just as will fatigue from bending over the sheaves.

Unequal tread diameter of the sheave's grooves is the most common cause of rope slippage. It is also the most destructive to the ropes, since when the elevator is in operation some of the rope must slip to compensate for the different rates of travel, unless means is provided to allow the ropes to adjust themselves to the conditions. Slippage, unequal loading, faulty stops, sheave grooves not suited to the size of the rope, and other causes will break the wire in elevator cables. Bending around the sheaves will cause fracture of the wires in the more flexible types as quickly as in the six-nineteen construction. Until it can be established what each factor contributes to the breaking, the reason for short rope life will remain conjectural, and the advocate of any rope type will have as favorable claim to superiority as another.

Why Not Central Power Plants For Industrial Groups?

DURING THE PAST YEAR several utilities have built, or proposed, plants near industries to which process steam will be supplied as a byproduct of power generation. Thus some utilities are now recognizing the opportunity for supplying such service, and that power may be generated at decreased cost under these conditions. In this may be observed the beginning of a trend toward the building of smaller central stations located near large industries requiring steam for building heating and manufacturing processes.

But why should industry wait for some utility to take advantage of such an opportunity, when, with a little co-operation, neighboring manufacturers can build a power plant to serve themselves with both steam and power? Opportunities exist to secure capital for such a plant on a payment-out-of-savings basis.

It may reasonably be expected that the combined steam and power loads of several plants will result in a more uniform demand for both these services and in better heat balance conditions. Because of these reasons and its larger size, the central plant should be able to supply power and steam at lower cost than can the utility or the power house of any individual factory.

Meter All Departments

DELIVERING reliable power services at the lowest unit cost is the primary duty of the power engineer in industry. Yet if he does this well and stops there he fails to serve his organization as he might. Because of his knowledge and interest in the generation of power the engineer has a moral responsibility in its application, and along with it a golden opportunity to make savings in its use.

In one sense it may be no concern of his if manufacturing departments waste his carefully guarded energy units. The fact remains that no one can see as well as the power engineer what causes this waste, what it amounts to in dollars and cents, and how it may be prevented. How, then, can he justify failure to apply this knowledge for the benefit of his employer?

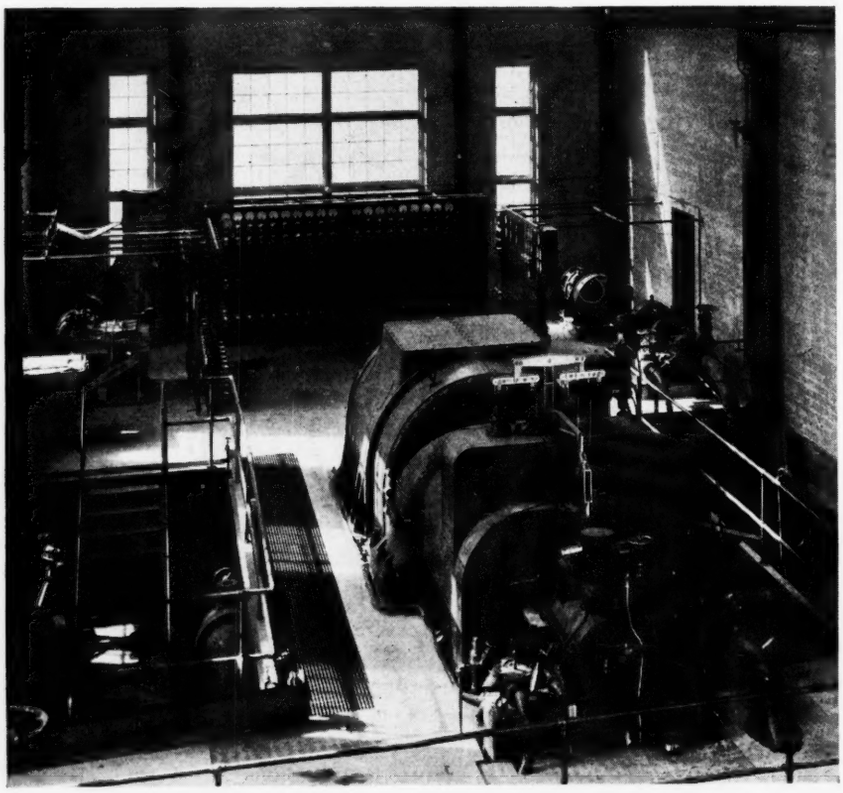
The first step toward elimination of wasteful consumption is to install departmental meters. These reveal surprising facts and—more important—establish responsibility. They make it possible to charge departments for steam, electricity, water, etc. Experience has demonstrated that consumption falls immediately when this is done. New low records are made by applying commonsense to the elimination of waste.

After obvious steps in this direction have been taken, the department head is in the mood to seek the advice of an energy expert—the power engineer—in an effort to reduce consumption still more. Thus the way is paved for additional savings.

Liquid Waste for Fuel—450-Lb. Pressure—Centralized Power-Factor Control

Are Features of PAPER MILL P

By Leo S. Weil
Mechanical and Electrical Engineer
New Orleans, La.



The plant contains one 7,500-kw. Westinghouse 3-phase 60-cycle 2,300-volt turbine-generator

A NEW 150-ton pulp and paper mill has recently been completed by the Gulf States Paper Corporation near Tuscaloosa, Ala. This installation contains many unusual features which make for economical operation and low cost of production. The mill is located on the Warrior River, about four miles from Tuscaloosa, and is served by the Warrior River and by three railroads, whose lines pass through the property. It is in the heart of the coal region of Alabama, and has the advantages of cheap fuel, ample timber supply and plentiful labor.

In the design of the plant, all factors that would help to reduce the cost of production were carefully considered. Much thought was given to the problem of obtaining ease of operation, in order to minimize the amount of labor required. An exhaustive study was made of power costs to determine whether it would be more economical to buy or to manufacture power, which is an important item in the cost of producing paper, and this study resulted in a decision to manufacture steam and power.

After a careful analysis of equipment and production costs with different steam pressures, a power plant design was worked out that called for the use of steam at 450-lb. pressure for the generation of power, and an extraction turbine from which steam is bled at reduced pressures for process work in the mill. Three steam pressures are carried through the mill: 450-lb. for power generation; 150-lb. for the digesters and concentrators; and 30-lb. for the dryers, evaporators and heaters.

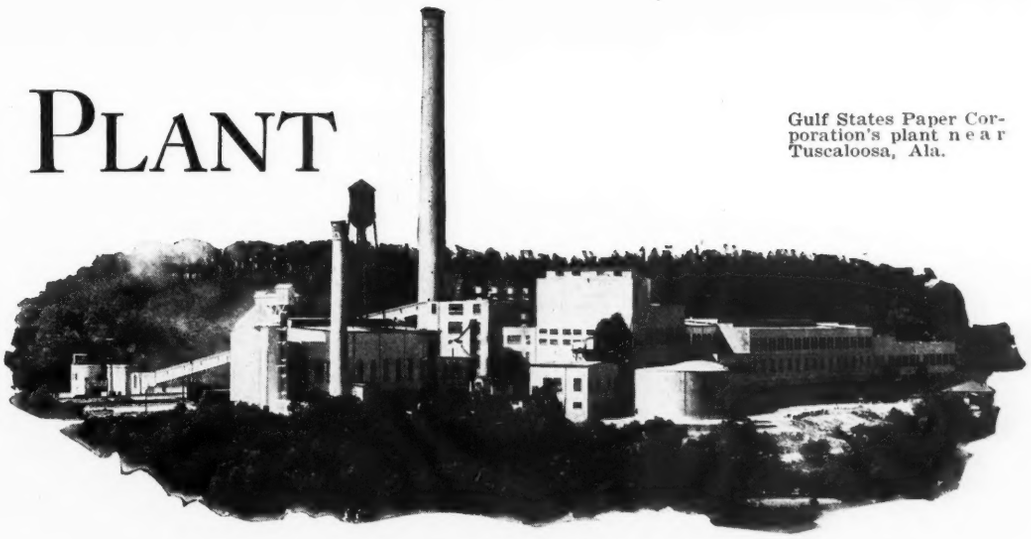
The high-pressure boilers and turbine are in a separate power plant building, which is situated between the mill proper and the Warrior River, this location being central for obtaining coal and water, and for the distribution of power.

In the boiler plant are three inclined water-tube boilers, each having 10,300 sq.ft. of heating surface. The boilers are designed for a working pressure of 450-lb. and have superheaters to give 200 deg. superheat. Water walls are used on the rear and the two side walls of each boiler furnace, the front wall being of firebrick. The water walls contain 1,200 sq.ft. of water-cooled surface each. Each boiler is equipped with a water screen, and the ashes are collected in the bottom of the furnaces in hoppers, from where they are sluiced away.

Each boiler is fired by two unit pulverizers, and one flare-type burner, the latter located in the front wall of the boiler. Air for combustion is supplied by fans, one fan for each boiler. The boilers, furnaces and pulverizers are designed to permit operating each boiler at a maximum rating of 90,000 lb. of steam per hour. Normally, however, each boiler will be expected to develop only 60,000 lb. per hour. The furnaces contain approximately 7,500 cu.ft. of volume per boiler, so that the heat liberated per cubic foot is within very safe limits.

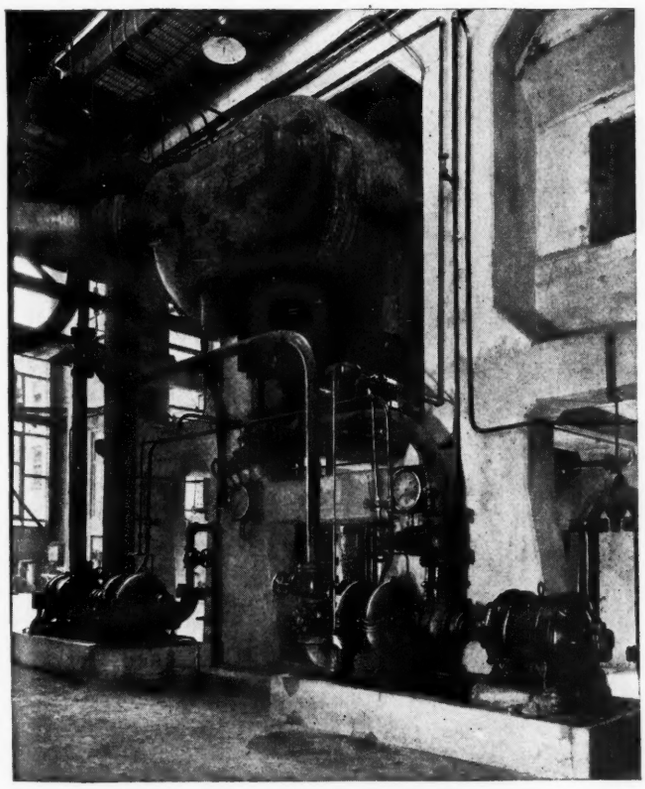
Draft is supplied by a concrete stack 14 ft. inside

L POWER PLANT



Gulf States Paper Corporation's plant near Tuscaloosa, Ala.

HIGH-PRESSURE STEAM ***has made possible new economies in supplying power and process steam to industrial loads. The plant described well represents modern practice. Power is generated by a 7,500-kw. turbine unit operating condensing and arranged to be bled at two points for process steam. Boilers, fired with liquid returned from the paper mill, supply 150-lb. process steam. The control of the mill's synchronous-motor field current is at the power plant switchboard, and allows the operator to adjust the power factor.***



The condenser is designed for 6,000 sq.ft. of tube surface, but only 5,000 sq.ft. are installed

diameter by 300 ft. high. The boiler plant is laid out to permit the installation of two additional boilers, which can be connected to this stack.

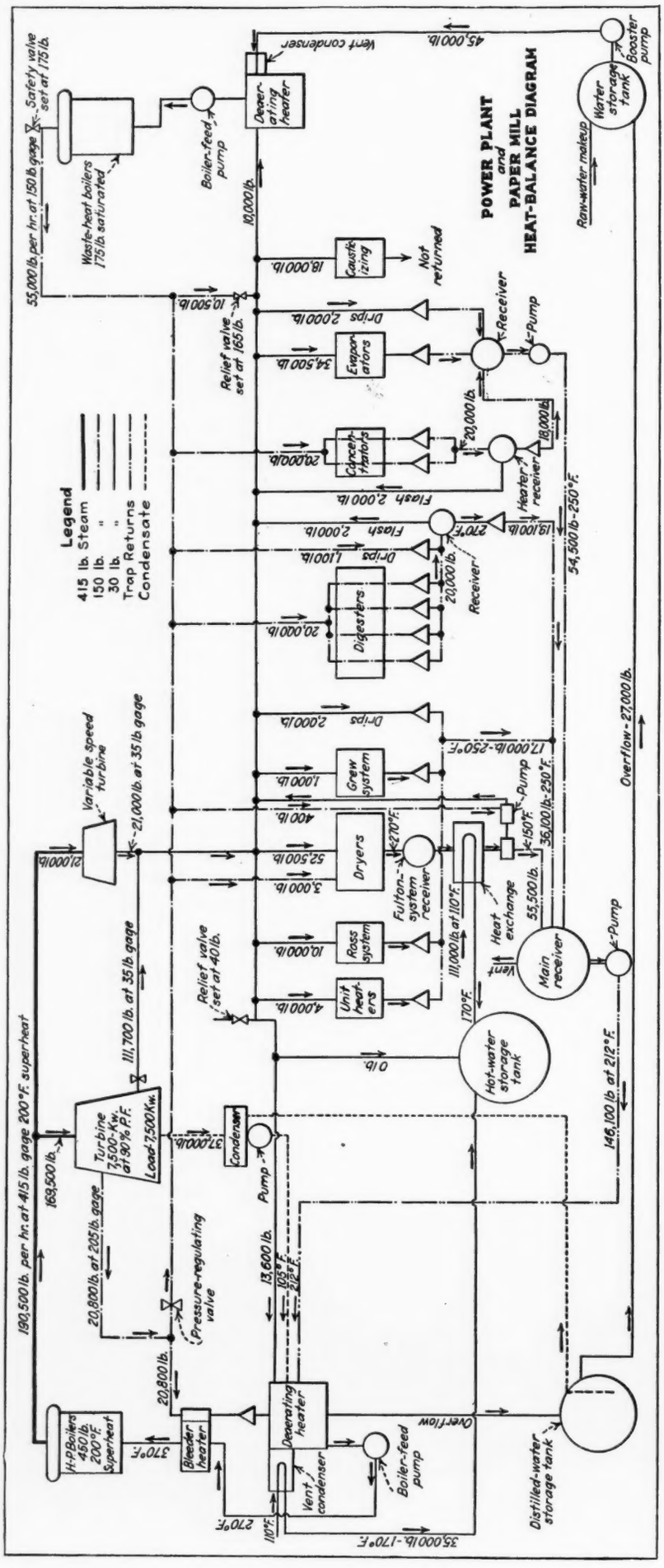
Coal, which is received in barges on the Warrior River, is stored in overhead bunkers in the power plant, being delivered into the bunkers by means of an inclined belt conveyor running from the river to the plant. The coal is picked up by a locomotive crane, located at the river, and is dropped into a hopper, from which it is delivered through a reciprocating feeder to the belt conveyor leading to the power house. A weightometer, for weighing the coal, and a magnetic pulley, for removing iron particles, are also part of the equipment.

Three centrifugal boiler-feed pumps are provided, two of which are motor-driven and one is turbine-driven. The suction of the pumps is connected to a deaërating heater, located on the roof of the power house. The pumps discharge through a closed heater in which the temperature of the feed water is raised to 370 deg. by means of steam bled from the first stage of the main turbine.

In addition to the high-pressure boilers in the power plant, steam is also generated in waste-heat boilers in the recovery plant. The recovery plant contains three boilers, having approximately 8,000 sq.ft. of heating surface each. The boiler furnaces are water-cooled, and are of a special design developed by William Cary, superintendent of the Gulf States Paper Corporation, in consultation with a representative of the Walsh Weidner Boiler Company, which built the boilers.

The boilers are fired with liquor, which is returned from the pulp mill and which is brought to high density in the evaporators and concentrators. This liquor is atomized and burns like an oil flame. No definite figures are yet available on the actual amount of steam so generated, but it is estimated that a minimum of 2,000 lb. per ton of pulp produced will be generated. For the present capacity of the paper mill, this is equivalent to about 54,000 lb. of steam per hour from the waste-heat boilers.

Steam is generated in the waste-heat boilers at a pressure of 150 lb. It is used for cooking in the digesters and for the evaporation of the liquor in the concentrators. If the waste-heat boilers do not make enough steam for this service, additional steam can be obtained by bleeding from the main turbine, or by means of a reducing valve in the 450-lb. line. If there is an excess of steam from



the waste-heat boilers above the 150-lb. requirements, this excess is discharged into the 30-lb. main through a specially designed reducing valve. The valve is so designed that it will not permit steam to be discharged from the 150-lb. line into the 30-lb. line, when the pressure in the latter rises above 30 lb. or when the pressure in the former drops below 140 lb. This double control is necessary to prevent the 30-lb. line robbing the 150-lb. line when excess steam is not available from the waste-heat boilers.

Steam at 30-lb. pressure is used in the dryers on the paper machine, in the evaporators and in various heating systems in the mill. This steam is obtained from the exhaust of the variable-speed turbine driving the paper machine, and from an automatic bleeder connection on the main turbine. The automatic bleeder connection on the main turbine is set at a pressure slightly below that of the regulating valve between the 150- and the 30-lb. lines, to permit the use of excess steam from the waste-heat boilers before bleeding steam from the main turbine.

Condensate Is Trapped

Condensate from the digesters, evaporators, concentrators, dryers and other process machinery is trapped and returned to a central receiver, from which it is pumped to the deaërating heater on the roof of the power house. A surge capacity of 10,000 gal. is provided in the deaërating heater, and any excess returns over the feed-water requirements of the high-pressure boilers is allowed to overflow into a distilled-water storage tank, which has a capacity of 17,000 gal. Water can be pumped back to the deaërating heater from the distilled-water storage tank when needed. When the distilled-water storage tank is filled it overflows into another tank, from which the waste-heat boilers obtain their feed water. Under this arrangement, more than sufficient returns will normally be available to supply the high-pressure boilers with distilled water. As it is possible, at times, for the returns from the process machinery in the paper mill to be contaminated with chemicals, a careful check is kept on the return water, and when polluted it is discharged to waste.

To take care of make-up requirements for the waste-heat boilers and also the emergency requirements of the high-pressure boilers, a treating plant for the feed water has been installed. This treating plant consists of pressure filters with a coagulant feed for clarifying the water, zeolite softeners for removing the hardness, and a phosphate feed for the proper conditioning of the water to prevent danger of caustic embrittlement. This phosphate feed is used only in connection with the high-pressure boilers, as the proper sulphate-carbonate ratio to prevent embrittle-

ment in the waste-heat boilers is obtained by the use of the coagulant feed ahead of the filters, without the necessity of after-treatment.

The heat-balance diagram gives a clear idea of the distribution of steam and returns between the high-pressure boilers, the waste-heat boilers, and the various steam-using equipment in the mill.

Electricity is generated by a 7,500-kw. 3-phase, 60-cycle, 2,300-volt turbine-generator, arranged for bleeding non-automatically at approximately 155-lb. gage and automatically at approximately 30-lb. gage. The pressure at the non-automatic bleeding point will vary with the load on the turbine and the amount of steam passing the turbine throttle. The pressure at the automatic bleeding point is adjustable by outside manual control to maintain any pressure from 25 to 40 lb., and this pressure is held constant at the desired point by the turbine governor.

The turbine is mounted over and used in connection with a surface condenser of the two-pass type. The condenser shell is of sufficient size to accommodate 6,000 sq.ft. of tubing, but only 5,000 sq.ft. is at present installed. The tube plates are drilled and plugged at both ends for 1,000 sq.ft. of additional tube surface, should it become necessary to install this at a later date. The reason for allowing this flexibility in the design of the condenser is because the quantities of steam to be bled from the turbine could not be definitely determined in advance. As the flow to the condenser would increase with any reduction in the amount of bled steam for a given load, it was thought advisable to build the condenser in this way to take care of any condition that might arise.

Cooling water for the surface condenser is pumped from the Warrior River, and after leaving the condenser, passes into a reservoir in the mill, from which it is pumped for general mill supply.

The condenser is equipped with two steam-jet air pumps, mounted on a common surface-type intercooler and after-condenser. Two two-stage motor-driven condensate pumps discharge the condensate into the deaërating heater, located on the roof of the power house.

Ventilating air for the generator circulates in a closed system and is cooled in a surface-type fin-tube air cooler.

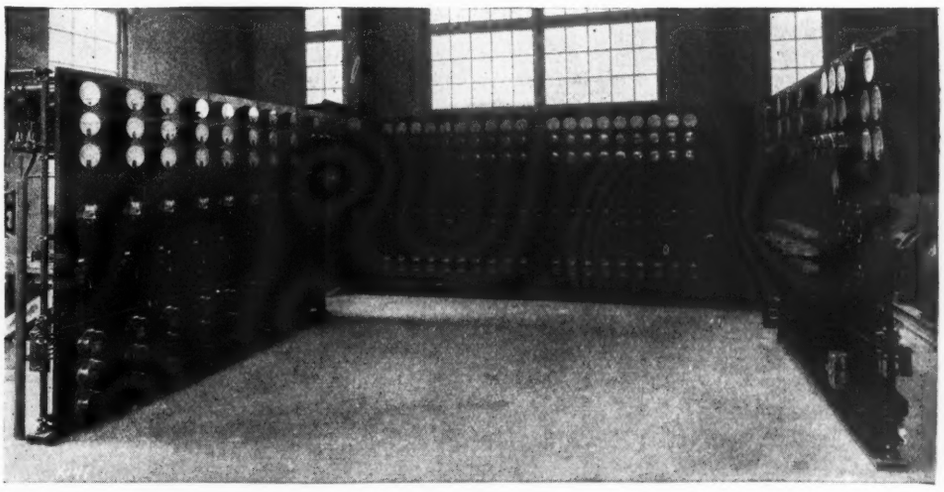
The generator is furnished with a motor-operated rheostat and motor-operated synchronizing device, differential protection and all other automatic accessories required for the full-automatic control of the turbine and generator from the switchboard. The switchboard, which is located in the electric bay at the end of the turbine room, is arranged in the form of a U, with the generator, exciter and relay panels on one side, the synchronous motor panels from which power factor is governed on the other side, and the panels for the control of the various feeder circuits to the mill on the third side. All three sides of the U are arranged to permit future expansion, and the operator's desk is in the center, from where he commands a view of the switchboard and generating unit.

There are two double exciter panels, containing three circuits, for the control of the three exciters. The exciters are all 60-kw. units, two being motor-driven and one turbine-driven. One of the motor-driven units is used in connection with the main generator, and the other supplies excitation to the synchronous motors in the mill. The two motor-driven exciters and the steam exciter are so interconnected that any one of the three can be used either to supply excitation to the main generator or to the synchronous motors.

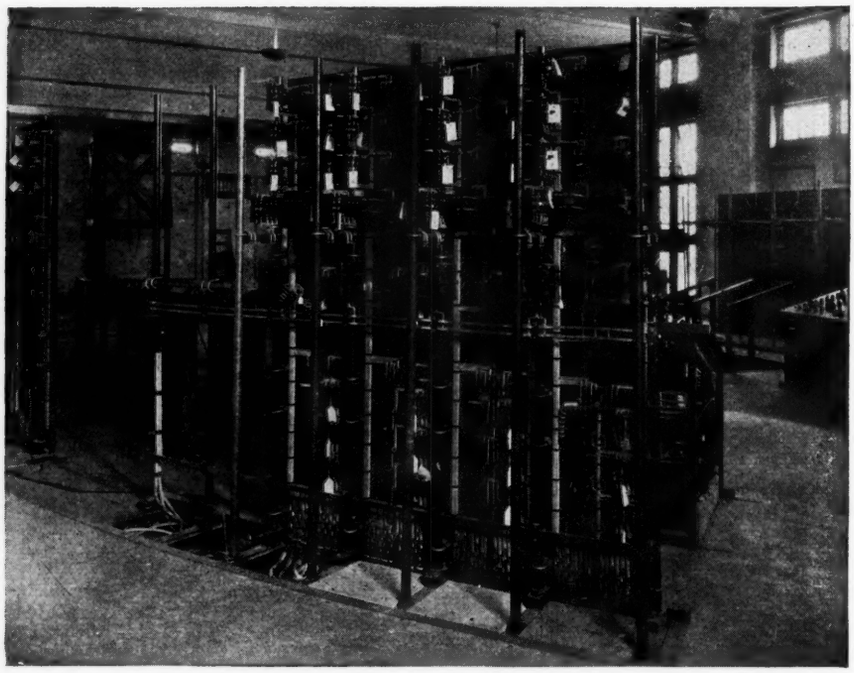
At the present time only one 7,500-kw. unit is installed; therefore, provision has been made for a tie-in with the Alabama Power Company to permit operating certain essential equipment in case of a shutdown of the turbine. Suitable provision for synchronizing with the power company is made on the switchboard.

The synchronous motor panels control from the power house eight 300-hp. synchronous motors, driving the Jordans located in the mill. The control equipment for these synchronous motors is in the power house, to permit the switchboard operator to adjust the power factor of the entire system by changing the field current of the synchronous motors. Each of the synchronous motors is provided with a motor-operated rheostat, which is operated from the synchronous motor panels.

This mill has now been in successful operation since the end of April, 1929. Chief credit is due to R. E. Hartman, vice-president, and to the other members of the management and operating organization, whose careful planning, tireless energy and technical skill were mainly responsible for the successful building of the plant, and for the many unique features that make for low cost of operation. Credit is also due to E. B. Severs and other members of the United Engineers & Constructors, which handled the construction of the power plant, and to the various contractors and sub-contractors, whose whole-hearted co-operation contributed largely to the rapid and successful completion of the project.



Switchboard is in the form of a U, with the generator, exciter and relay panels on one side; the synchronous motor panels, from which the power factor of the system is controlled, on another side; and the panels for the control of the various feeder circuits to the mill are on the third side



Control cables run to terminals at the rear of the switchboard.

Here Is a SPECIFICATION *for Control Cable*

By H. M. Friend
New York City

CONTROL CABLE is an important part of modern power plants, but very little has been published on its selection and application. In two previous articles, Nov. 19 and Dec. 3, 1929, numbers of *Power*, essential information necessary to intelligently selecting, inspecting, installing and testing control cable was given. In this article a specification is presented adherence to which will insure obtaining cable representing best modern power plant practice.

Conductors: The conductors shall consist of stranded annealed copper wire uniformly tinned, and conform to specification B-8-27 of the American Society of Testing Materials. The stranding shall be that known as concentric and comply with Table I. A cotton wrapper shall be applied over each conductor in the cable to act as a separator between the copper and the rubber insulation.

Insulation: The insulation shall consist of either a rubber compound or the compound known as Kerite. If a rubber compound is used it shall consist of a minimum of 30 per cent by weight of the highest grade new hevea rubber, mineral fillers, waxy hydrocarbons and the proper quantity of sulphur to vulcanize the compound.

As the Kerite insulation is a secret compound, manufactured only by one company, there are no restrictions as to its composition.

If the manufacturer has developed an insulation that possesses characteristics superior or equal to the previously mentioned compounds he may submit bids based on this compound.

The thickness of insulation shall be 3/64 in. for wire sizes No. 12 and 9 A.W.G., and 1/16 in. for sizes No. 7, 6, 4 and 2.

The wall of insulation shall be uniform in thickness, with the average not less than that previously specified. In no place shall it be less than 90 per cent of that specified.

Identifying Colored Braids: Over each insulated conductor shall be applied a closely woven identifying cotton braid not less than two-ply, impregnated with a transparent moisture-proof compound.

For a single-conductor cable this braid is not required. Each conductor of a multiple-conductor cable shall have a distinguishing braid in accordance with the color plan in Table II.

For a cable containing a greater number of conductors than in Table II the braids of the remaining conductors may have colored threads crossing each other in a white braid. By using the colors red, black and green 21 additional conductors may be identified.

Where only one color is specified, the braid shall be 100 per cent that color. Where two colors are specified, the braid shall be 50 per cent of each color and woven in zig-zag stripes of equal width and at right angles to the axis of the conductor, as in Fig. 1.

Where three colors are specified, each color shall compose one-third of the braid, in stripes as in Fig. 1.

Arrangement of Conductors: For a two-conductor cable, the conductors are to be laid parallel, with no fillers. Where more than two conductors are required they shall be laid up with a spiral lay, the lay of each succeeding layer being reversed. For cables containing three or more conductors the spaces between the outside conductors shall be filled with jute to form a compact round core. Over this core shall be applied one layer of single-faced rubber-filled tape, with an overlap and with the smooth side next to the conductors.

Marker: Between the layer of rubber-faced tape and the outer covering the manufacturer will provide an identifying marker that contains his name and date of manufacture.

Weatherproof-Braid Covering: If a weatherproof braid is specified, it shall consist of one closely woven cotton braid not less than two-ply, that is, impregnated with a moisture-proof compound. The cable is to be finished by polishing smooth after passing through a bath of black wax.

Flameproof-Braid Covering: If a flameproof braid is specified, it shall be that known as slow-burning and consist of one closely woven cotton braid not less than two-ply thoroughly impregnated with a flameproof paint. A flameproof finishing compound is to be used and the

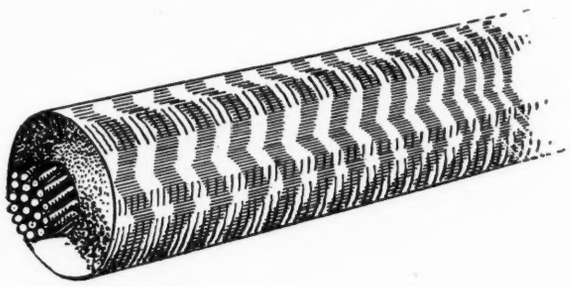


Fig. 1—Braid coloring woven in zig-zag stripes around the conductor

braid finished smooth. The color of the completed cable shall be a dark slate gray.

Leaded Covering: When a lead sheath is specified, it shall be composed of virgin lead not less than 99.85 per cent pure. The thickness of the lead sheath is given in Table III.

The average thickness of the lead sheath shall be not less than specified, and in the minimum thickness is not to be less than 90 per cent of the specified thickness.

The lead sheath shall fit the core of the cable tightly and be free of cracks and flaws.

Guarantee: The manufacturer shall guarantee that the cable is free from defects in design and that the material and workmanship are of the highest quality. If any length of cable fails in service within two years from date of manufacture, due to defects in design, materials, or workmanship, the manufacturer must replace it free of cost to the purchaser.

Inspection: Inspection and testing of cable is to be made at the manufacturer's plant by a representative of the purchaser. This inspection will consist of: (1) a preliminary inspection, and (2) a final inspection.

Preliminary Inspection: A high-voltage electrical test shall be made on each of the insulated single conductors before the colored braids are applied. The conductors are to be immersed in water for at least 12 hr., after

TABLE I—NUMBER AND SIZE OF STRANDS IN CONDUCTORS

Nearest Size, No. A.W.G.	Number of Strands in Conductors	Size of Each Wire, No. A.W.G.	Approximate Diam. of Conductors, In.	Actual Area, Circ. Mil.
12	19	25	0.090	6,088
9	19	22	0.127	12,198
7	19	20	0.160	19,380
6	19	19	0.180	24,510
4	37	20	0.224	37,740
2	37	18	0.282	60,091

which the voltage is applied between the conductors and the water.

Based on the thickness of insulation as previously given, the test voltage shall be 3,000 volts for conductor sizes Nos. 12 to 9 and 3,500 volts for Nos. 7 to 2, and shall be applied for five minutes. This test voltage shall have a frequency of 60 cycles, approaching as nearly as possible a sine-wave form.

After the high-voltage test, the insulation resistance between the conductor and water shall be measured and calculated in megohms per 1,000 ft. at 60 deg. F. These values shall be not less than those given in Table IV.

Any conductor that fails on the voltage test, or the insulation resistance of which is less than that specified, shall be rejected. The manufacturer may patch such conductor and offer it again for inspection, but the mechanical and electrical strength of a patched conductor must be equal to, and its outside diameter shall not be greater than, the rest of the insulation.

The physical dimensions of the conductors shall be measured by the purchaser's inspector.

The maximum allowable variation in diameter of the copper strands shall be + 0.001 inch.

The average thickness of the insulation shall not be less than that specified, and the minimum thickness not less than 90 per cent of the specified thickness.

Physical tests are to be made on the rubber insulation, and for a 30 per cent compound shall be as specified in Bulletin 63 of the A.I.E.E. The tensile strength of the compound shall not be less than 1,000 lb. per square inch. When a sample with bench marks 2 in. apart is stretched to 6 in. between the marks and then released the distance between the bench marks is not to exceed $2\frac{3}{8}$ in. after two minutes. The elongation at rupture shall be at least 9 inches.

Chemical analysis on samples of the rubber insulation may be made at the option of the purchaser. The requirements shall be those of Bulletin 63 of the A.I.E.E. For Kerite or insulation other than a 30 per cent rubber compound these requirements do not apply.

Final Inspection: For lead-covered cable a high-voltage test shall be made between the conductors and the

TABLE II—NUMBER OF CONDUCTORS AND BRAID COLOR FOR CONTROL CABLE

Number of Conductors	Color of Braid
1	White
2	Black
3	Red
4	Green
5	Yellow
6	White–black
7	White–red
8	White–green
9	White–yellow
10	Black–red
11	Black–green
12	Black–yellow
13	Red–green
14	Red–yellow
15	Green–yellow
16	White–black–red
17	White–black–green
18	White–black–yellow
19	Black–red–green
20	Black–red–yellow
21	Red–green–white
22	Red–green–black
23	Red–green–white
24	Yellow–green–white
25	Yellow–green–black

sheath. The test voltage is to be of the same value and applied for the same time as for the preliminary inspection. This would mean as many tests as there are conductors, but to decrease the number of tests the following plan may be used:

For a two, three- or a four-conductor cable with a lead sheath, two tests are required: On a two-conductor cable, No. 1 wire is connected to the lead sheath and test voltages applied between No. 2 wire and the sheath. In the second test, No. 2 wire is connected to the lead sheath and the test made between the sheath and No. 1 wire. When the cable has a braided covering the test voltage is applied between the two conductors only. The diagram, Fig. 2, shows the arrangement of the conductors in the cable.

In a three-conductor lead-covered cable, wires 1 and 2 are connected to one side of the test circuit and wire No. 3 and the sheath are connected to the other side. When making the second test No. 1 wire and the sheath are tested against No. 2 and 3 conductors. When testing a four-conductor cable, wires 2 and 4 are connected to the sheath and tested against No. 1 and 3, then 1 and 3 are connected to the sheath and tested against 2 and 4.

Five-conductor cables with a lead sheath require three tests. In one, wires 2 and 4 are connected to the sheath

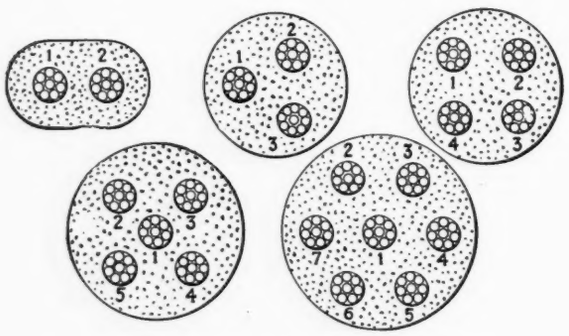


Fig. 2—Arrangement of conductors in control cables

and tested against 3 and 5. Wires 3 and 5 are connected to the sheath and tested against 2 and 4 in a second test. For the third test, wires 2, 3, 4 and 5 are connected to the sheath and tested against No. 1.

Seven-conductor cables with a lead sheath can be tested by three groupings of the conductors and the sheath. First, wires 2, 4 and 6 are connected to the sheath and voltage applied between them and wires 3, 5 and 7 as a group. In the second test, wires 3, 5 and 7 are connected to the sheath and the test made against 2, 4 and 6 as a group. Wires 2, 3, 4, 5, 6 and 7 are connected to the sheath in the third test and voltage applied between this group and wire No. 1.

The same plan can be worked out for a larger number of conductors.

For a flameproof- or weatherproof-braided cable the voltage shall be applied between conductors and shall be of a value twice that used for the preliminary inspection. As there is no grounded sheath, a voltage test to ground is not required.

TABLE III—THICKNESS OF LEAD SHEATHS FOR CONTROL CABLES

Outside Diam. of Cable Core, In.	Sheath Thickness, In.	Outside Diam. of Cable Core, In.	Sheath Thickness, In.
0 to 0.50	3/64	1.126 to 1.50	3/32
0.51 to 0.75	1/16	1.51 to 2.00	7/64
0.76 to 1.125	5/64	over 2.00	1/4

TABLE IV—MINIMUM INSULATION RESISTANCE PER 1,000 FT. OF CONTROL WIRES, SPECIFIED BY A.I.E.E.

Size of Conductors, No. A.W.G.	Insulation Thickness, In.	Minimum Megohms Per Mile
12	3/64	7,100
9	3/64	6,050
7	3/64	4,500
6	1/16	4,500
4	1/16	3,950
2	1/16	3,450

Insulation resistance shall be measured between conductors for braid-covered cable and between conductors and to the sheath for lead-covered cable. These values shall be not less than those given in Table IV.

Physical Measurements: The outside diameter of the completed cable shall not exceed the specified values.

The lead-sheath thickness shall be measured with a round-nose micrometer and must average not less than the specified value, while the minimum thickness shall not be less than 90 per cent of that specified.

Gasket Tests of 1350 Lb. Piping Joints

A SPECIAL STUDY was made by the National Valve & Manufacturing Company of the behavior of various types of gaskets and joints under a steam pressure of from 1,200 lb. to 1,500 lb. and at temperatures to permit efficient and economical operation. The maximum thermometer reading was 700 deg. F.

The tests, under the direction of R. R. Monteith at the laboratories of the Babcock & Wilcox Company, Bayonne, N. J., were made with a header especially constructed for the purpose. All materials used were those specified under the 1,350-lb. tentative American standard, with the exception that Class B flanges were used in place of Class C, which were not obtainable. Both monel metal and composition asbestos gaskets were tried.

During the initial test the composition asbestos gaskets in the male and female bypass connections blew out at a pressure of 1,200 pounds.

As the tests were continued at increasing pressures the failure of the composition gasket in the plain-face center joint, and the slipping of the other gaskets suggested the advisability of using corrugated monel metal gaskets, which, as disclosed in succeeding tests, gave no signs of movement or deterioration.

During the final stages of the steam test, using a pressure of 1,500 lb. and a total temperature of 700 deg. F., corrugated monel metal gaskets treated with a light application of oil and graphite were used. They held tight, even with a bending stress on the header, for a period which was felt sufficient to disclose any weakness.

The operation was then repeated with 1,500 lb. pressure. This time a spring of 0.052 in. was produced. Under these severe conditions all joints held tight, with no sign of leaks or movement in the gaskets.

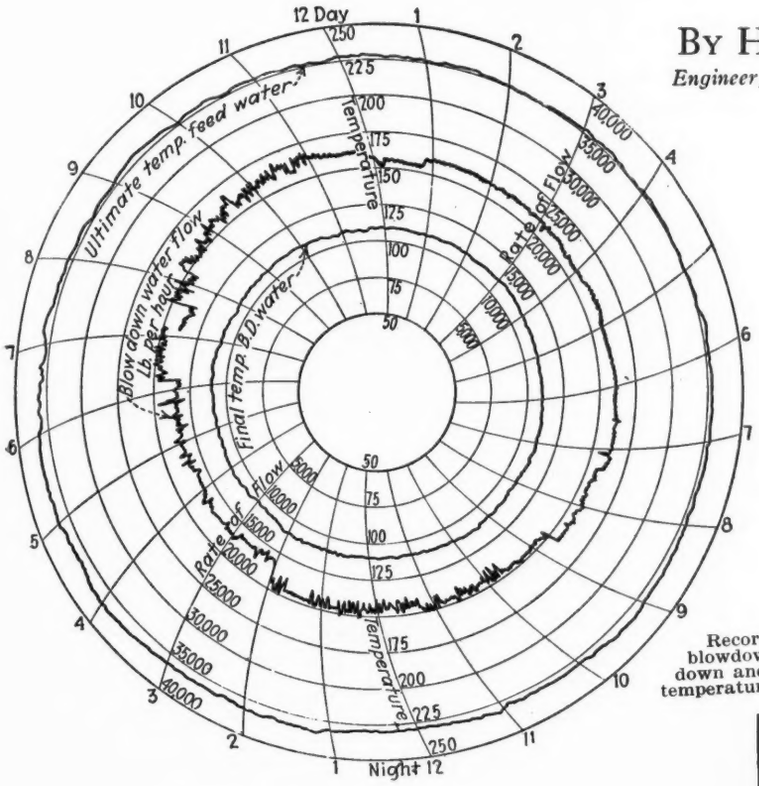
Uncoated monel metal gaskets were next installed, and pressure was carried up to 5,000 lb. The plain-face joint leaked slightly and the phonographic- and serrated-face joints an extremely small amount.

The gaskets were then removed and the lips on the joints were sealed by arc welding. Water pressure was again introduced to the header. At 3,000 lb. the plain-face joint leaked about one drop every five minutes. The phonographic- and serrated-face joints held tight up to 7,000 lb., at which point the latter leaked slightly. The The phonographic finish held tight through the period.

Continuous Boiler Blowdown

Effects Savings at Armour Plant

By H. K. Blanning
Engineer, Armour & Co., Chicago



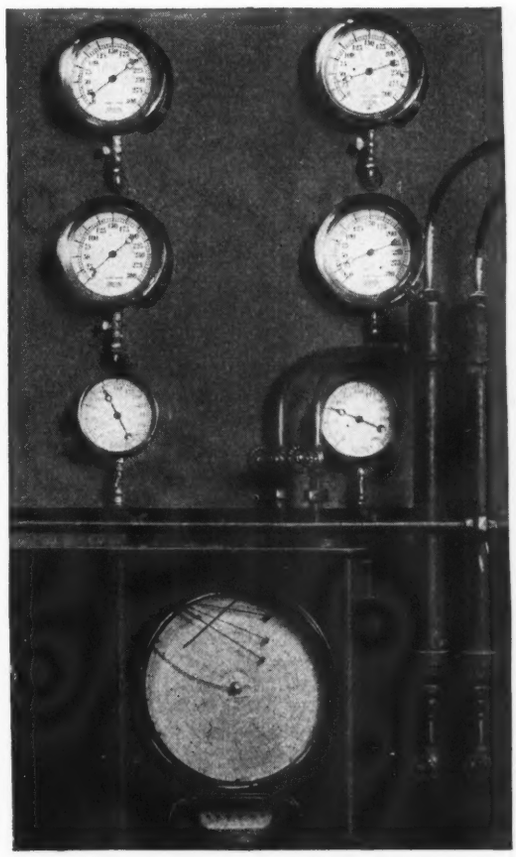
Record of total blowdown and blowdown and feed-water temperatures.

FOR any given plant, with a given design of boilers, rating demands and feed-water chemical characteristics, there is a definite maximum total concentration of dissolved and suspended solids that can be allowed beyond which maximum the steam delivered will be uneconomically wet and an uneconomical amount of scale will be deposited. In explanation of these terms, it is well known that no boiler delivers perfectly dry steam. The steam should be kept as dry as possible coincident with the capital expense of drying the steam to the ultimate; the point at which no further expense is warranted determines the economically wet steam point. In the case of the economical scale quantity, consideration must be given to the cost of feed-water treatment versus the cost of turbining the tubes.

Armour & Company control boiler water concentrations by titrating both the feed water and boiler water for chlorides with a silver-nitrate solution. The feed-water titration divided into the average boiler water titration gives as the quotient the number of times the feed water has been concentrated in the boiler by evaporation; the reciprocal of this concentration is the percentage of blowdown, after making due allowance for the moisture carried out of the boiler in the steam. This is done daily.

Weekly tests are made of the titrated feed and boiler water to determine gravimetrically the dissolved and suspended solids. The total solids, gravimetrically determined, divided by the chloride titrations gives a factor of grains total per cubic centimeter of titration. This figure is used by the boiler room operators to determine and control blowdown. But it was not completely satisfactory, in that it resulted in high maintenance of blowoff valves, irregular steaming owing to the temporary unbalance of the rate of heat generation and the rate of feed-water flow to the boiler, and loss of heat to the sewer; so that uniform concentration of the total solids in the boiler water was impossible to maintain.

About a year ago the general problem of boiler blowdown was investi-



Blowdown control panel. Flow meter below records total blowdown

gated. It was determined to install a continuous system of boiler blowdown, with heat-recovery apparatus, at the company's Kansas City plant. Here the boiler equipment consists of four 5,830-sq.ft. boilers of the cross-drum type, with feed-water regulators and 50-deg. superheaters; and eight 5,000-sq.ft. Stirling-type boilers with hand-regulated feed-water control. All the boilers are fired by natural gas and are equipped with the usual flue-gas thermometers, steam-flow meters, CO_2 recorders, draft gages, etc. The feed water is treated in an intermittent system softener having four 62,000-gal. tanks, but no filters. The lime, soda ash, sodium aluminate treatment is used. All boiler feed water is measured by fluid meters. The steam load averages between 3,500,000 and 4,000,000 lb. per day, delivered at 160-lb. gage pressure and an average of 99 per cent quality.

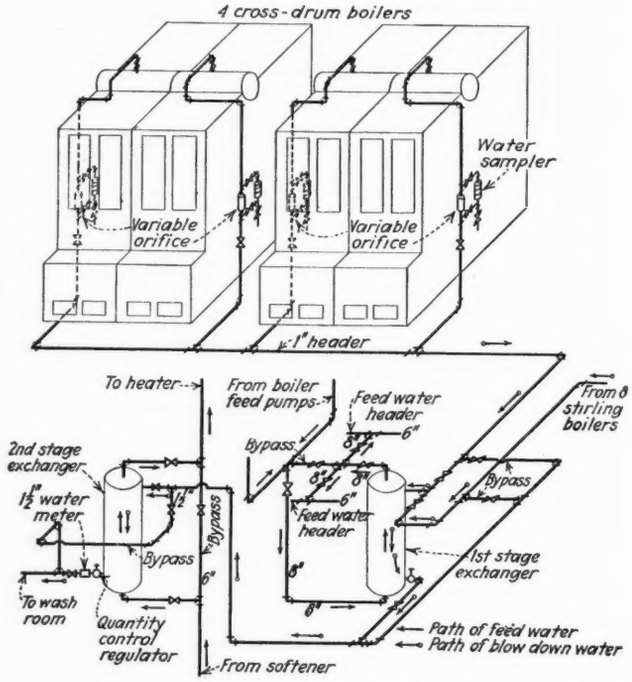
The blowdown apparatus and piping connections are shown in the diagram. Operation of the system is as follows: The 85 per cent feed-water make-up requirement is drawn from the water softener and is pumped to the second-stage exchanger at a temperature of 110 deg., where it comes in contact with the 220-deg. blowdown water from the first exchanger, picking up 7 deg. in temperature. The feed next passes to the regular open-type feed-water heater and then through the boiler feed pumps at a temperature of 218 deg. to the first exchanger, where it comes in contact with the 365-deg. blowdown water direct from the boilers and after attaining an ultimate temperature of 230 deg. passes on into the boilers.

Blowdown water is drawn from the steam drum just below the surface of the water, the amount being regulated by a variable-orifice control at the side of the boiler. From the control the water flows through the first exchanger, where it drops 145 deg. in temperature and goes to the second exchanger.

Between the first and second exchangers is a spring-loaded ball regulating valve that holds a constant pressure of 120-lb. gage on the first exchanger, thus giving a 40-lb. differential between the boiler pressure and the entrance to the second exchanger.

After leaving the second exchanger the water passes through the flow nozzle of a meter that records, integrates and indicates the flow of blowdown water and records the final temperature of the feed water and the discharge temperature of the blowdown water on one chart. From this meter the blowdown water passes through another spring-loaded regulating valve that holds a pressure of 70-lb. gage on the second exchanger, giving a 50-lb. differential between the two exchangers. First plans were to discharge the blowdown water to the sewer, but as described later, a better use was found for it.

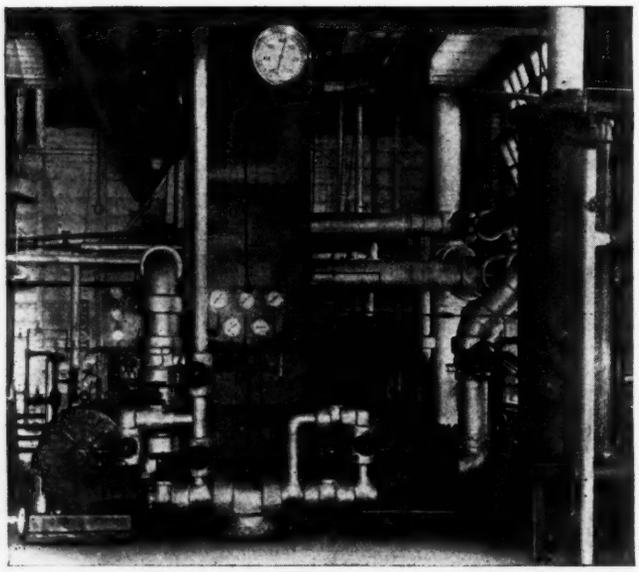
Both the first and second-stage exchangers are identical in construction, being essentially the same as the usual surface steam condenser, except that a special floating head was designed to take care of the expansion incident to wide changes in temperature. The shells are of welded construction. Feed water passes through the tubes, and the blowdown water circulates outside the tubes, baffles directing the blowdown water along the most efficient path. Bypasses around each exchanger for both the feed and blowdown water permit cleaning the exchangers if it becomes necessary.



Isometric diagram of continuous blowdown system

Being sterile, soft, and with slight alkalinity, the blowdown was found to make an ideal washing water for removing animal fats from both wooden and metal surfaces. Also it was at about the required temperature. The blowdown water is pumped direct to the wash room, where all meat-curing vats, fresh-meat shipping boxes, ice cases and fresh-meat chilling trays are washed and sterilized. As there is approximately 40 gal. per minute of blowdown water available, a considerable money saving in the wash department has resulted through the elimination of the soda-ash requirement and by cutting down the amount of steam required for heating the water.

For guidance of the operators of the blowdown system a gage board was provided. The four upper gages show the boiler feed-water pressure entering and leaving the two exchangers. They are intended to detect dirt



Boiler feed pumps, with one of the exchangers at right

accumulation in the exchanger tubes, but so far have been found unnecessary. The pressure drops through the exchangers vary from 1 to 4 lb., depending upon the load. The two bottom gages indicate the pressures of the blowdown water in the two exchangers, and the flow meter below the panel records the total water blowdown.

By changing the settings of the quantity control valves at the outlet of the exchangers, more or less water in total is blown from the boilers. The control pressure gages show the pressure in the exchangers corresponding to a given setting of the quantity control regulators and hence are a definite guide as to how much water is being blown from the boilers. The necessary variations in the amount of water to be blown from the individual boilers are taken care of by adjustments in the variable-orifice valves at the boilers.

Data Taken on 48 Days' Operation

The specimen chart from the continuous blowoff water meter shows the total amount of water blown down, the temperature of the blowdown water as it leaves the second exchanger and also the final temperature of the feed water just after it leaves the first exchanger.

For a period of 48 consecutive days detail data were tabulated on the operation of the continuous blowdown. Over this period 17,743,000 lb. of water was blown from the boilers, which, based on the meter record, was equivalent to 7.96 per cent of the total water fed to the boilers. The average temperature of the make-up water to the second exchanger was 110 deg. F., and the average temperature of the blowdown water leaving the second exchanger, 116 deg., giving a terminal difference of 6 degrees.

Raw water to the softener averaged 7.9 gr. per gallon soap hardness and 6.7 gr. per gallon methyl-orange alkalinity. The treated water leaving the softener averaged 0.7 gr. per gallon soap hardness, 6.2 gr. per gallon methyl-orange alkalinity and 4.1 gr. per gallon phenolphthalein alkalinity. The chemical charge for treatment averaged 1.55 lb. of hydrated lime, 1.17 lb. of soda ash and the equivalent of 0.4 lb. of No. 2 sodium aluminate per 1000 gal. It was necessary to vary the treatment some 20 per cent, but the treated water analysis stayed practically constant.

Average boiler water concentration, determined by titration of hot boiler water, was a total of 215 gr. per gallon of dissolved and suspended solids, with the dissolved averaging 208 gr. per gallon and the suspended averaging 7 gr. per gallon. That the sodium aluminate has proved effective in rapid and efficient settling and clarification of the treated water is indicated by the low quantity of suspended solids in the feed and boiler water, particularly in view of the fact that no filters are used in conjunction with the softener.

The concentration figures were arrived at by titrating each boiler water, the samples being drawn direct without cooling. Consequently, the true solids concentration figure would be about 16 per cent lower, owing to the flashing of some of the superheated boiler water into steam upon sudden reduction to atmospheric pressure from the boiler pressure. Correcting the figures for that error, the total concentration of solids in the boiler water would be 180 gr. per gallon, with the dissolved matter at 174 gr. per gallon and the suspended matter at 6 gr. per gallon.

To eliminate this error a small sampling drum was secured to cool the sample before the pressure was released. The cooler is attached to the continuous blowoff line of the boiler just below the variable-orifice valve, and results show approximately 16 per cent lower concentration when it is used.

Since installing the continuous blowdown system, one Stirling boiler has operated 355 hr. with a total of 4,088 steaming hours since the last turbining of the tubes. Ordinarily, the boiler would have needed cleaning when opened, but practically no scale was found on the tube surfaces and no sediment in the mud drum, so it was put back in service without being cleaned. From the results on this one boiler it would appear that scale and sediment are being deposited more slowly than they were before.

The direct heat saving, based on the observations made over the test period, are readily calculated. During that period 17,743,000 lb. of water were blown from the boilers that previously would have been a total heat loss. This water left the boilers at a temperature of 365 deg. F. and was discharged from the second exchanger at a temperature of 116 deg. F., or a net difference of 253 B.t.u. per pound. Neglecting radiation loss from the exchangers and piping, which in any case could not amount to more than 1 per cent, the heat saving would be as follows: The total heat recovery is the product of the water blown and the heat recovery per pound, or 4,488,980,000 B.t.u. During this period the fuel gas averaged 1,008 B.t.u. gross per cubic foot, and cost $0.159 per 1,000 cu.ft. Adjusting the heat recovery for the average over-all efficiency of the boilers (75 per cent), the total fuel gas saved amounts to 5,937,000 cu.ft., or $944 for 48 days, a saving of $7,180 a year. The installation will, therefore, pay for itself in slightly more than a year.

Pulverized Fuel Notes

THE REPORT on "Pulverized Fuel" just issued by the Prime Movers Committee, N.E.L.A., shows a decided trend toward unit mills for both industrial and public utility plants. The aggregate boiler horsepower under contract in January, 1929, is compared with that installed in 1928 as follows:

	Industrial Plants	
System	1929	1928
Unit	54,000	32,000
Central	6,000	34,000
	Public Utility Plants	
System	1929	1928
Unit	38,000	27,600
Central	22,000	11,600

Lubrication troubles were reported for the roll type of mill, and vibration difficulties for the ball type with screen separation. Several companies improved results with the first type by changing from grease to oil lubrication.

Exhauster fan blades averaged 10,000 tons per set.

The loss due to combustible in the fly ash varied from a fraction of 1 per cent to 5 per cent, with isolated cases as high as 10 per cent. The actual combustible in the fly ash varied from 1 to 35 per cent, with one plant reporting 49 per cent for bituminous coal.

Kilowatt-hours per ton for coal preparation and transportation with bituminous coal was as low as 13.3 in one plant and as high as 24.6 in another, although the average was around 18. One plant burning anthracite reported 28.4 kw.-hr. per ton, whereas two burning a mixture of one-half anthracite and one-half bituminous reported 21.3 and 21.9, respectively.

Why Not More *Economical* Power Plant Design?

Simplification and Intelligent Investment Produce Dividends

By W. S. Johnston
Mechanical Engineer, New York

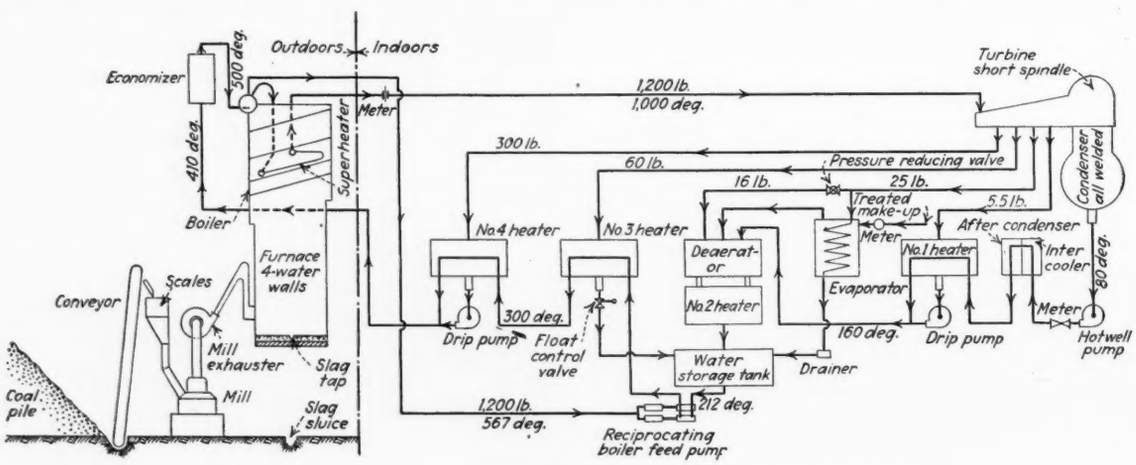
A GROWING DEMAND for greater financial return on capital invested in public utility electric systems compels engineers to strive now for simplification and investment economy in designing central power plants. For some years past, since the advent of high-priced fuel, the goal has been maximum heat economy. Today a modern power plant, with its numerous heat traps, devoted to the production of electricity is one of the most complex manufacturing institutions making an every-day commodity.

The offhand figure of $100 per kilowatt of installed capacity is frequently exceeded, though some plants show an investment of less than this. Real progress has been made, however, in increasing the economy of steam plants until today their total production costs are competitive with what we are pleased to call cheap hydro power. This is now the case in California and may become true also at Niagara Falls and other places. Investment bankers will insist in the future that there be less spread in the ratio of fixed charges to operating costs at the expense of the former.

Geographical location of a plant may greatly influence its cost. There is small probability of establishing entirely new systems in a country such as ours already covered with a gigantic network of transmission systems. Yet there may be some opportunities in the Western plain states. In such cases available water supply, fuel sources and load centers will determine the plant sites, real estate in the country being relatively inexpensive if judiciously purchased. On established systems land prices assume greater importance because the projected plant must tie in with the balance of the system and may have to be located in or close to a populous center. With a trend toward outside installations, ample elbow room is essential and there should be adequate land at low cost. An interesting recent case is that of the new State Line station, where a 73-acre site was reclaimed and filled in at the southern tip of Lake Michigan: A costly undertaking, but there was afforded a plot with water on three sides and space for future expansion.

The location should also influence the architecture of the plant buildings. In isolated places there is little or no justification for ornate designs. Exterior curtain walls must be substantial and strongly built to withstand wind stresses. Effective designs, where more than ordinary exterior walls are required, may be developed with well-laid hard-burned brick. The use of expensive pressed brick or terra cotta for interior finish adds nothing to the utility of the structure. While these features are nice and may increase the morale of the operating staff, they produce no greater return than a well-laid wire-cut brick wall. Division walls between the steam and electrical generating equipment are no longer essential, the Toronto, Ohio, station being one of the pioneer plants built without one.

A structural steel frame supports the weight of the



Economical investment heat diagram (preheated air included)

plant equipment. Designing engineers are prone to use high impact factors, often up to 100 per cent. In some cases, as for forced- and induced-draft fans, this percentage may be justified, but in others 25 per cent is probably sufficient. In one successful station—that at Sterlington, La., where, because of cheap fuel, fixed charges are twice the operating costs and it was essential to reduce the former—only 25 per cent was allowed for impact, and the building structure is remarkably free from vibration when the turbine-room crane is in motion. Welded construction offers an avenue for economy in steel design, although, to the writer's knowledge, it has not been used for any power plant building. If alloy steels decrease in price, their use may be justified, as the working stresses can be steppd up from 18,000 to 24,000 lb. per square inch with a corresponding decrease in the total weight. A silicon steel is used for the structural members, excepting roof trusses, at the Richmond station in Philadelphia to permit the use of smaller members.

While it is obvious that investment can be curtailed by using lower-cost material wherever essential quality is not sacrificed, a bold step is to decrease the building volume required. This has been done at a number of hydo plants, where generating equipment is in the open and protected against the weather by steel plate hoods easily removable by the crane used for installation and maintenance of the units. Just how far one may be warranted in proceeding along this line in the case of a steam plant is as yet unknown. Although heat-carrying lines and equipment are as thoroughly insulated as is economically warranted, considerable heat is radiated, and this may be increased if the ambient temperature is lowered under conditions obtaining in a Northern plant during the winter. It will be interesting to note the radiation losses on the heat balance of the first large boiler unit installed outside, for it is believed this part of the plant will be taken out from under the roof before the main generating units with their feed-water heating equipment can be safely placed outdoors. But there is certainly an opportunity for economy in such a thought that may well be used in warm climates at least—say as far north as Southern California on the west to North Carolina on the east.

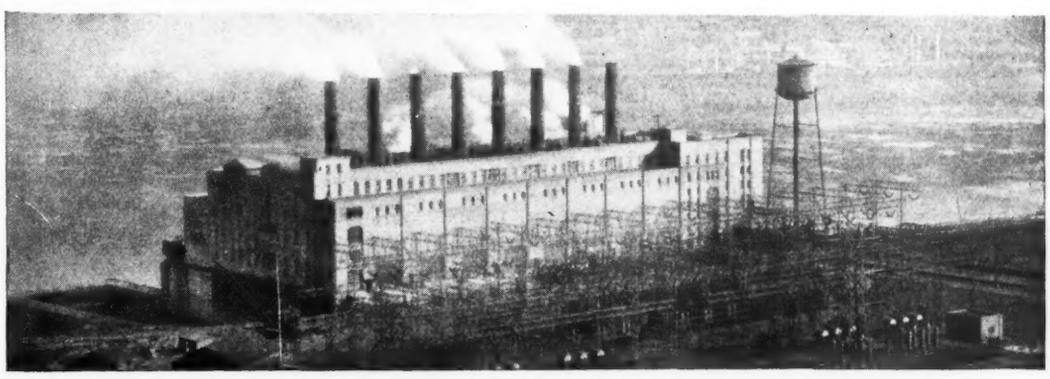
Then, too, what is so precious about coal that it must be housed in great bunkers at the top of the building. In the future coal will pass continuously from a receiving or reclaiming depot to the preparation or firing equipment, and with outside boilers the structure required for housing steam-generating equipment is reduced to a minimum. Overhead bunkers are a heritage of the time when coal had to be fed by gravity to a hopper and building structures were considerably lower.

Considering the plant equipment, wide strides have been made to secure greater economy in the use of high-priced fuel. Numerous devices have been conceived and used to convert into useful work as much as possible of the original heat in the fuel. Elaborate and extensive studies are made to substantiate the contention that thermal gains will be secured by their use. But it is questionable if many of those in vogue today are really worth their cost. The general rule applicable in most cases is that the investment in fuel-saving features is justified only to the extent that they earn their fixed charges by savings based upon conservative estimates of probable annual capacity factors, at the same time considering the possibility of changes in the cost of fuel delivered and prepared during the useful life of the equipment.

The road to greater investment returns lies in the direction of increasing output and decreasing capital requirements; general simplicity in station layouts compatible with reasonably high efficiency, probably involving higher steam temperatures; and better reliability of equipment, thus decreasing outages and eliminating duplication and reserve capacity. How far one may go with these various factors depends on the limitations of the problem in hand.

There is a trend toward higher steam pressures and temperatures, and the reheat cycle has been developed to diminish turbine losses. The present reheat equipment is costly, and it appears worth-while to investigate the possibilities of increased steam temperature which will allow increased pressure without reheating.

The procedure of the Pacific Gas & Electric Company in selecting the last 37,500-kw. machine for its Oakland, Calif., steam plant is an example of close buying. Ordinarily, one would purchase a 17-stage impulse turbine or a reaction type of 24 to 50 rows of blades for this rating, whereas only a 9-stage machine was installed. It has better efficiency at light loads and up to 30,000-kw.



Toronto station, where division wall between steam and electrical generating equipment has been omitted

output, and from that point to its maximum capacity, 42,000 kw., it has but slightly poorer economy under full extraction conditions than the conventional 17-stage turbine. The machine is bled at four stages, and its efficiency is within about 1 per cent of the ordinary unit; yet $1.50 per kilowatt was saved in building-foundation and turbine costs. Why doesn't this kind of a unit suggest itself for carrying peak loads in a station already containing two or more high-economy units? It may also be used for generating bulk kilowatt-hours in an emergency without seriously penalizing annual unit production costs.

A recent innovation was seen in the surface condenser field, at the Broad River Power Company's Parr Shoals station, where a 27,000-sq.ft. condenser is the first of all-welded construction. It affords reduction in weight and first cost, and some operating advantages may be secured over a cast-iron shell by elimination of air leaks through the body of the metal and at the joints.

One Boiler per Turbine Likely

Employing larger generating units is doubtlessly real economic progress. The day is not far away when large electrical units and equally large boiler units will be grouped together on the basis of one boiler for each generating unit. Records of the past several years indicate that the present steam turbine-generator is highly reliable and not afflicted with serious or prolonged outages under normal operating conditions. It is believed an investigation of the performance of larger boiler units will indicate their availability factor is practically equal to that of the turbine-generators. If a reciprocating boiler-feed pump is developed for use with this combination steam and electrical generating unit, there need be neither a spare pump nor a feed-system header, as the boiler is supplied directly by its own pump. A plant laid out on this basis would be much simpler and would require investment in essential equipment only, without appurtenances that contribute but little in real earnings. It would obviate duplication of pipe lines, eliminate bypasses, crossovers and other features presumed to afford reliability and continuity but which are of questionable value.

Care in Selection of Auxiliaries

Auxiliary equipment should be carefully selected to eliminate any that is unnecessary and avoid spare capacity not required. Sizes must be chosen so as not to require operation under severe overload. Drives for auxiliaries may well be designed so that under normal operating conditions they give high efficiency, while capable of sustaining considerable overloads for reasonable periods at reduced efficiencies. There is an inclination to believe real savings exist in using variable-speed drives, which, if they are electrical, involve complicated control equipment. It is difficult to attack them, because there is no way of determining the actual savings accruing from their use. It is thought, however, in so far as operating results are concerned, that multiple-speed drives are equally satisfactory and no more expensive from the operating standpoint; while their first cost is less. This is particularly true in the use of two-speed motors for fan drives. Load conditions may not permit of their use in connection with boiler-feed pumps, but there is little to be gained by using other than single-speed motors on less essential pumps.

It is recommended that engineers responsible for power plant designs spend some time in accumulating accurate performance and test data from the equipment they have purchased. For this there is no better school than a plant subject to the service conditions of a growing public utility. Fortified with definite knowledge and facts, they may approach the design of a new plant and the selection of its equipment with more confidence that the return on the investment may be accurately predicated and with greater assurances that it will be realized.

While designers must be progressive, they should not widely espouse new and untried developments, in either general design or equipment, and commit their companies to the inherent hazards involved. Rather, as new equipment is brought out it should be tried in but a few stations and not universally adopted by all until its merits have been proved. The writer does not wish to discourage pioneering, but to point out that it is likely to cause considerable trouble in a station for the first few years of its operation and that during this period it contributes little or nothing to profits. Public utilities will do well if they insist that their engineering staffs design and construct conservatively, using that which has been proved to be the most economical in present-day practice and with which manufacturers and operators are most familiar. Then a station is likely to function as intended and produce revenue from the start.

Formula for Computing Loss Due to Combustible in Furnace Refuse

By Raymond F. Forbes

IN THE Dec. 31, 1929, number *Power* published a formula for computing loss due to combustible in furnace refuse. The formula was correct, but as heat value of coal is usually specified "as fired" and ash percentage is usually given as dried coal, I do not believe it is as complete a formula as the one I have developed for computing the percentage of the "as fired" heat in coal lost by combustible in the refuse. It is as follows:

$$\frac{(1-\%\ moisture\ in\ coal)\ (\%\ combustible\ in\ refuse)}{(1-\%\ combustible\ in\ refuse)} \times \frac{(\%\ ash\ in\ coal)\ (14{,}600)\ (100)}{(B.t.u.\ per\ lb.\ coal\ as\ fired)} = Per\ cent\ heat\ of\ fuel\ lost\ in\ combustible\ in\ refuse.$$

Take for example a coal with an analysis as follows: 10.15 per cent moisture, 10.65 per cent ash, 11,300 B.t.u. per lb. as fired, and 21 per cent combustible in refuse. The loss due to combustible in ash is

$$\frac{(1.00 - 0.1015)\ (0.21)\ (0.1065)\ (14{,}600)}{(1.00 - 0.21)\ (11{,}300)} \times 100 = 3.28\ per\ cent.$$

In this formula the percentages are expressed as decimals.

Proposals on Dimensions on Drawings—Methods for indicating dimensions on drawings have been studied by the A.S.M.E. Sub-committee No. 2 of the Sectional Committee on the Standardization of Drawings and Drafting Room Practice. The committee has completed a proposal which it recently presented for discussion, covering dimensioning lines and figures; expressing feet and inches; finish marks; dimensioning holes, diameters and limits.

WATER TREATMENT FOR DIESEL PLANTS

By L. A. Pease
Fairbanks, Morse & Company

THE use of a naturally soft or a softened water for cooling in a Diesel plant is imperative to satisfactory operation. Rarely can cooling water be obtained that does not require treatment. Only pure rain or melted snow, or a supply from soft water lakes or rivers will do. Long rivers pick up gases, dirt and sediment and absorb incrustating solids from rock formation.

There are many scale-forming solids in natural waters, and they vary in quantities and combination; in fact, it is quite difficult to find any two waters alike in this respect. The scale-forming content of many waters varies over wide ranges from season to season, making the problem of maintaining pure soft water a major operating difficulty. The principal salts found in water are sulphate of lime (gypsum), calcium carbonate (lime stone), sulphate of magnesia (epsom salts), carbonate of magnesia, silica and oxides of iron and alumina. The solids are dissolved in the water in passing through or coming in contact with earth containing them.

The various solids cause two kinds of hardness: temporary and permanent. Calcium carbonate and carbonate of magnesia and iron, plentiful in nature, are but slightly soluble in pure water, although large amounts are dissolved by water containing carbon-dioxide gas, which is present in all waters in contact with the earth.

Where such waters come in contact with calcium, magnesium and iron, they form compounds known as bicarbonates, which cause what is called temporary hardness, because they are readily deposited upon the liberation of CO_2 gas through application of heat.

Permanent hardness, caused by the presence of salts of lime and magnesia, usually the carbonates, chlorides or nitrates, is not easily removed by physical means. Some of the salts are very soluble, causing large quantities of natural hard water.

The harmful action of these incrusting solids is usually due to the manner in which they are combined with each other, and with other impurities, rather than to the actual quantity of any one solid. When they are liberated in an engine water jacket by the heat of the engine, the solids come in contact with the heated iron surface and cling tenaciously, in most cases forming a hard and highly insulating surface. This prevents the passing of the heat to the cooling water and results in injury to the engine.

One common method of removing solids is to add chemicals to the water before it enters the cooling system, the chemical reaction releasing the incrusting solids, which are removed by settling or filtration.

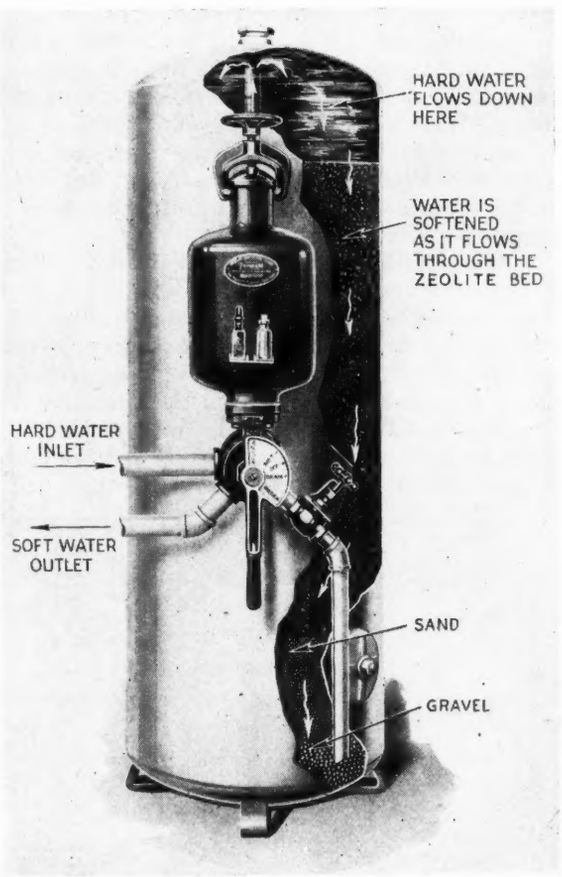
The chemical alone, however, does not solve the operator's problem. He still must use judgment and not permit too great a concentration of solids in the water, with their consequent slow accumulation of scale. It is next to impossible to reduce the hardening properties to zero under normal operating conditions, and when scale in the water jacket reaches $\frac{1}{32}$ in. it should be removed with acid or chemical, as directed by the engine manufacturer or chemical company.

Another method, most commonly used, is the zeolite or exchange-silicate softener. This agent is used in both its natural and synthetic state, and for Diesels constitutes a very satisfactory softener. The total hardness of most natural waters is almost completely removed by merely passing it through a column of prepared zeolite. This requires intelligent operation on the part of the operator, who must not permit the concentration of soluble salts to exceed about 3,000 grains per gallon, which can be checked with a hydrometer, and he must not let the softener continue to run after the zeolite has given up all its sodium salts. This is readily determined by a simple chemical testing apparatus, furnished with the softener. The zeolites used are silicates of aluminum, iron or other metal combined with the bases sodium or potassium. These silicates possess the property of exchanging their associated bases for the calcium and magnesium of the water.

Water coming through the zeolite bed exchanges the sodium base for the calcium and magnesia in the water, reducing the water to zero hardness, the calcium and magnesium being retained by the zeolite. The chemical reaction is as follows: Sodium zeolite + calcium bicarbonates = calcium zeolite + sodium bicarbonate.

This continues until all of the exposed sodium salts are used up. If more raw water is passed through, it will not be affected and will enter the system in its virginal hard state, permitting scale formation. The exchange process is the reverse, the chemical reaction being: Calcium zeolite + sodium chloride = sodium zeolite + calcium chloride.

The reactions for the magnesium are the same as the calcium. The amount of water passing through at each regeneration depends upon the type of zeolite used and the hardness of the water. The zeolite water softener is quite simple in construction and is easily installed.



A zeolite softener for Diesel plants

Reducing Heating Costs by

Night Control

By JOHN L. McCULLOUGH
Direct Control Valve Company

The development of heating system controls has forcibly brought out the large steam savings possible by preventing overheating. Similar savings may be obtained by operating the heating system to procure maximum cooling of the building during the unoccupied hours. This article indicates data needed for efficient night control.

THE PURCHASE of central station steam for heating office buildings was probably the most important influence operating to develop greater economy in the use of steam. When the older engines furnished exhaust steam there was little reason to conserve the quantity used, but with the newer, more economical engines or purchased steam there is an incentive for economy. Faced with the problem of developing an infant industry, the central heating men turned to the prevention of waste as a means of reducing the cost of purchased steam while maintaining a unit price sufficiently high to let the steam company exist and grow.

Many false steps were made—but much of value has remained from their efforts. The development of economy systems utilizing the lower temperature of steam under vacuum, the improvement in distribution through the use of orifices, the application of the single thermostat to control, and the development and refinement of room-temperature control: all these can give some measure of credit to this agency.

A new problem, however, is confronting the managements of office buildings—that of space rental competition. Two factors enter into this, service and cost. Nothing can be done in operating the building to detract from the former, and every item that goes to make up the latter must be scrutinized. In the larger buildings heating costs are such a big item that they will bear the expense of an intensive study.

In the Oct. 22, 1929, issue of *Power* many opinions on the subject of economical night cooling were expressed. The consensus was that night cooling was economical unless some specific condition made it impractical. This is in line with the central heating companies' experience.

Heat supplied to the building makes up heat losses from the building. The total heat loss from the building is made up of a number of components that can all be classed under two heads: first, conduction of heat through walls, windows and doors; and second, dissipation of heated air, replaced by air at outdoor temperatures.

The temperature carried inside the building directly affects both these losses. If this is not true then the statement that there is economy in the prevention of overheating is not true, and no one will deny that it costs more to overheat a building at 80 deg. than to maintain 70 or 71 deg. By the same logic, then, the lower the temperature the lower the costs. There are, however, limits beyond which temperatures cannot be dropped. It is not practical to lower the temperature to a point where plumbing is endangered, or to a point from which too long a time will be required to return it to the desired occupancy temperature. Therefore, the governing factors are these limits, and particularly the heating rate of the building.

At night the building should be allowed to cool at its own rate with steam entirely shut off—as long as the temperature does not go below the danger point for plumbing. If we know the rate at which the building can be warmed up for any outside temperature, then steam can be turned into the system in sufficient time to have the building at the occupancy temperature when the tenants begin to arrive.

When considering any plan that allows lower temperatures at night, one point should be kept in mind. The furniture, floors, walls and other contents of a building tend to give up their heat to the building air as its temperature drops. This heat must be supplied again in the morning, and it will be found that there is a lag in the heating process. That is to say, the desks and chairs will be cooler than the air in the building for a definite period after the air is up to temperature. No tenant will like

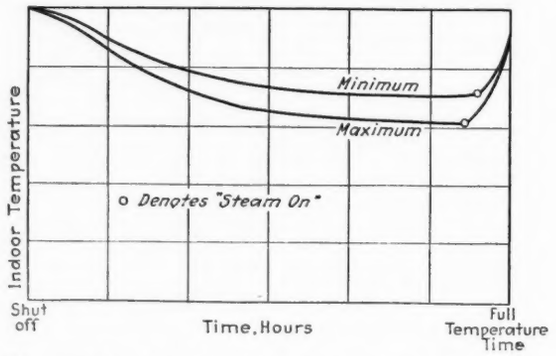


Fig. 1—Maximum and minimum cooling rates for 45-deg. outdoor temperature

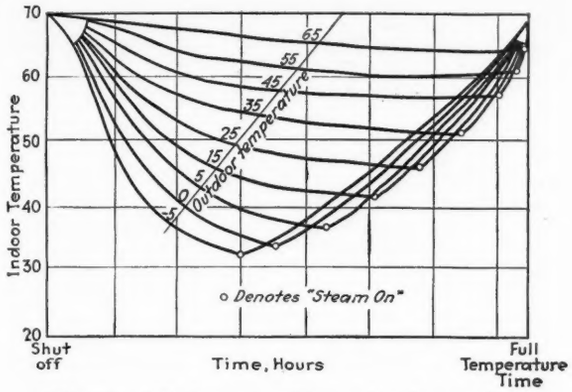


Fig. 2—Minimum cooling rates for various outdoor temperatures

this, so it is advisable to reach the day temperature a short time in advance of the time of occupancy, in order to allow desks and chairs to reach room temperature.

Every building, if any attempt is to be made at economy, should be equipped with one or more thermometers, recording at a central point, preferably the engineer's headquarters. By adding an outdoor temperature recorder, data can be gathered on the cooling and heating rates and a curve plotted for that particular building, for each outdoor temperature. Due to variations in wind velocity, the points obtained will cover a considerable area, but the minimum rate curve should be used as a base. A correction, which will be explained later, can be made on this base. Fig. 1 shows a typical cooling and heating curve. The scale of hours has been left blank, as no two buildings will be the same, and typical rather than actual illustrations are used.

If all the curves for the various outdoor temperatures were consolidated, they would appear as shown in Fig. 2. Fig. 3 is the engineer's chart plotted from the data from the curves in Figs. 1 and 2. The dotted line is the base line curve and does not include any correction for warming the building contents, or for wind velocities. The solid line, obtained from experience, allows for warming the desks and chairs by reaching the desired temperature shortly before the tenants arrive.

Fig. 4 is the chart for correction due to wind velocities. It is obtained from data on Fig. 1. The maximum rate shown indicates what changes are effected in cooling and heating due to wind. Thus, if the base rate of cooling indicates that an indoor temperature of 52 deg. should be obtained at a certain time through natural cooling, and the indoor thermometer reads 48 deg., a correction should be made to offset this in warming the building, and the

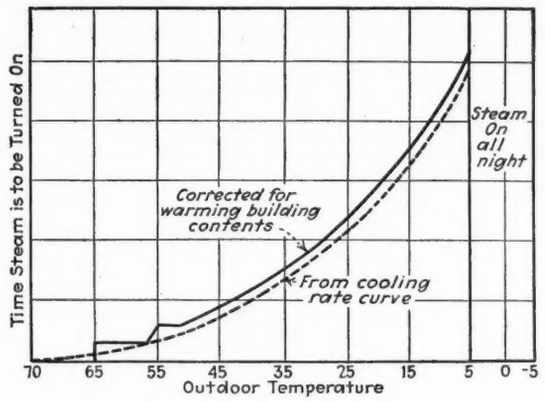


Fig. 3—Chart showing time to turn steam into system

time for turning steam into the system set ahead the proper amount. Experience will soon show the form of the curves on this chart, from study of the temperature recorders.

The engineer reads the outdoor and indoor thermometers at certain hours, say 9 p.m. and midnight. The curves as shown on his chart, similar to Fig. 2, will show what the resultant indoor temperature should be at that hour. If the indoor temperature is lower, the allowance to be made is found on a correction chart similar to Fig. 4. From his chart, Fig. 3, the time to turn steam on is chosen directly and the allowance made, and steam is turned into the system at the time indicated.

The plan will work as satisfactorily when steam is generated as when purchased. If overloads are experienced on the boilers, the operation of the pressure-regulating valve, which should be in every system to admit steam

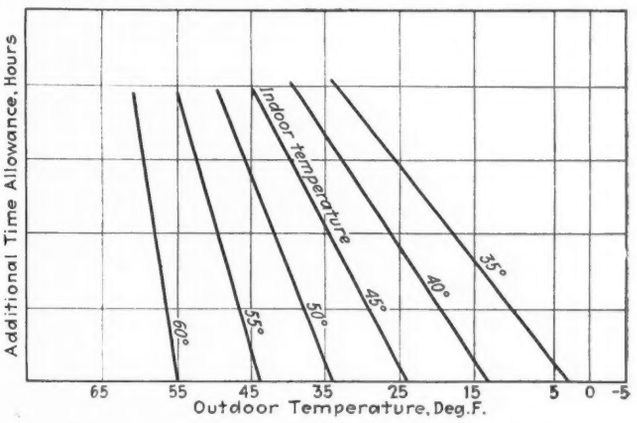


Fig. 4—Chart showing allowance to be made for wind conditions other than minimum

at low pressure a short time in advance, will warm the mains.

With adequate temperature control no difficulty will be encountered during the day; but some overheating can be prevented through observation of the recording thermometer, cutting off steam when overheating is indicated and turning it back in when the building cools. The supply of heat from lighting and other sources may be sufficient to maintain the temperature desired without the use of the heating system in mild weather.

Detroit Has Low System B.t.u. Rate

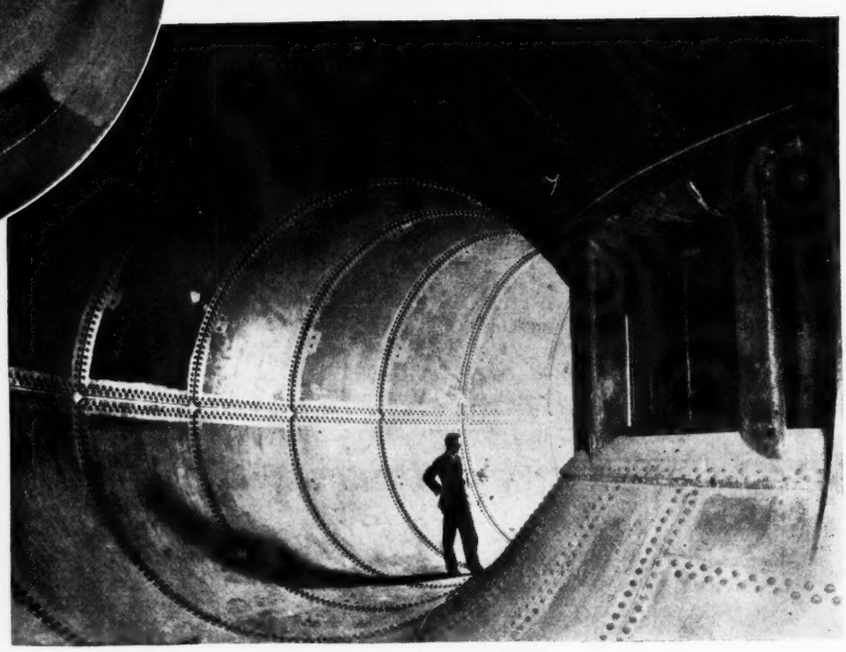
BEFORE a meeting of the American Institute of Electrical Engineers and the Detroit Engineering Society, Alex Dow, president of the Detroit Edison Company presented some data regarding the operation of the Detroit Edison plants, which will make most utility operators just a little envious.

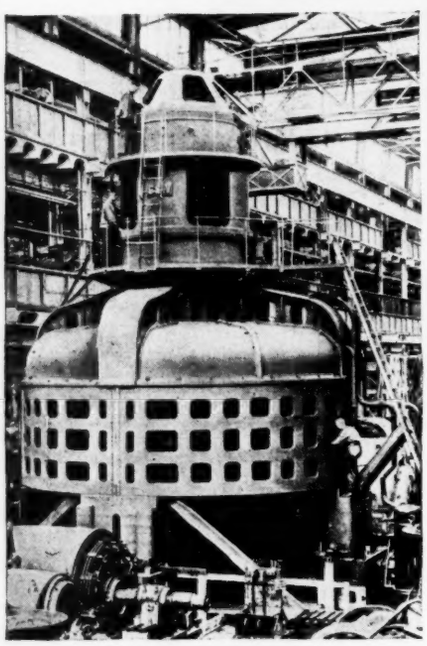
The net output of the Detroit power houses to transmission and distribution lines was, in the twelve months ending last October, 2,637,753,600 kw.-hr. This entire net output, which does not include auxiliary power, was generated for 16,840 B.t.u. per kilowat-hour.

Of the total net output Delray produced 298,000,000 kw.-hr. for 22,000 B.t.u. per kilowatt-hour; 755,000,000 kw.-hr., were produced at Marysville for 19,290 B.t.u. per kilowat hour, and Marysville dropped to 15,430 B.t.u per kilowat hour, with an output of 417,000,000. Trenton Channel, which has furnished over 40 per cent of the entire output, has a record for twelve months of 14,390 B.t.u. per kilowatt hour.

MORE POWER *for* IRELAND

The River Shannon—inspiration of poets—now turns the wheels of industry and lights the homes of labor. Penstocks 23 feet in diameter lead to the three 40,000-hp. turbines now installed. The ultimate capacity will be 250,000 kw.





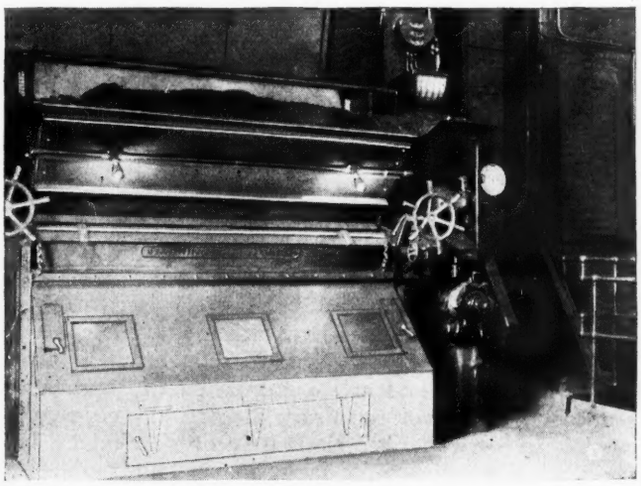
Above—Scroll case. Left—Generator of one of the 40,000-hp. units operating under 110-ft. head

Burning Coke Breeze and Anthracite Screenings

BYPRODUCT COKE from the gas plant of the Fitchburg Gas & Electric Light Company, Fitchburg, Mass., has largely been disposed of to the local market, but the coke breeze could not be sold. So it was up to the boiler room engineer of the power plant to use this fuel in conjunction with bituminous and anthracite coal.

The boiler room contains five boilers all fired with underfeed stokers. First it was attempted to use the coke in the stokers without mixing with coal. From a combustion viewpoint this was reasonably successful, but the hard coke acted like emery on the moving parts of the stoker, causing excessive wear. This action was so rapid that in two months it was found necessary to replace all of the rams of the stoker that had been used to fire the coke.

Then the coke was mixed with the coal, in an endeavor to reduce wear on the stoker. Although heavy and light fires and different settings of the stoker dampers were



Chain-grate stoker installed to burn coke breeze and anthracite screenings

tried, it seemed impossible to fire the mixture so as to obtain satisfactory combustion.

The difficulty appeared to be due to the fact that thorough mixing of the coal and coke was unattainable, and the coke, because of its free-burning characteristics, burned out faster than the coal, leaving holes in the fire. Furthermore, if the underfire pressure necessary to burn the coal were carried, it blew the coke off of the grates. The holes formed caused tuyere burning and of course, firing difficulties.

Finally, in order to make use of this fuel and also some anthracite screening that was available, it was decided to alter one of the 5,000 sq.ft. boilers. The underfeed stoker was discarded and replaced by a Harrington chain-grate stoker driven by an induction motor through a Reeves variable-speed drive. Five air zones, each capable of individual adjustment, make close regulation posible. Both front and rear arches, of the Bigelow-Liptak suspended type, have been provided to assist ignition and improve combustion.

A forced-draft fan maintains a constant static pressure in the wind box, and the boiler is operated at a constant load, which averages 28,000 lb. an hour.

The bunker above the boiler is partitioned off from the rest of the plant bunker, and the coke breeze and anthracite screenings are delivered to it as they become available. This results in the stoker sometimes receiving coke and sometimes coal.

A fire between 5 and 6 in. deep is maintained for anthracite, and the grate travel is adjusted to about 3 in. a minute. When the coke breeze appears in the stoker hopper the depth of fire is increased to about 10 in. and the grate travel increased to about $4\frac{1}{2}$ in. per minute. Operated in this manner, an evaporation of about 7 lb. of steam per pound of fuel as fired, or an efficiency of about 72 per cent, is obtained.

The new stoker and boiler setting has permitted a considerable portion of the boiler load to be carried with fuel that costs between $4 and $5 per ton instead of with bituminous coal at between $7 and $8 a ton.

Utilization of Blast-Furnace Gas By French Power Stations Increasing

IN A LECTURE recently delivered before a joint meeting of the British Institution of Electrical Engineers and the Société des Ingenieurs Civils de France, in London, L. A. E. Sekutowicz and A. Evain gave an account of the electrical plant and network of the Société Electrique de la Siderurgie Lorraine. The lecturers described the steps that have been taken to link up the metallurgical power stations in the Lorraine region and to dispose of the electrical energy produced by the utilization of surplus blast-furnace gas.

The first part was devoted to a description of the installations. The interconnected stations run along the frontier (Chiers Valley) and in the valleys of the Rivers Fentsch and Orne, which are tributaries of the Moselle. The distance between the most distant stations does not exceed 31 miles. Of fifteen stations located in the French part of the mining area, ten are connected to the network, and their total power is about 125,000 kw., though not all of the units are permanently connected to the network. The machines consist of five four-cylinder gas engines, twenty two-cylinder gas engines, fifteen turbine-alternators, and six converter groups, connecting works which run on direct current. Of the total power supplied to the network 56 per cent is contributed by gas engines, 36 per cent by steam turbines, and 8 per cent by converters. If the generating units in the stations supplying the converters are included, the proportion of steam turbines drops to 32 per cent.

It was pointed out that a hydro-electric station operated by running water is incapable of storing its own reserves, and is obliged to turn to another source should the flow of the river become insufficient. A metallurgical station, on the other hand, if equipped with boiler and steam turbines, is self-sufficient, and can cope with variations in the output of blast-furnace gas by using coke-furnace gas or coal.

To insure new outlets for the increased production of energy the company has already interconnected two large distribution networks in Alsace and Lorraine and in the Vosges, and has participated in the creation of two new companies to construct high-tension lines to join up with the Paris region and the North of France via the Ardennes.

Right Out of the Plant

Cause of Wear in Air Compressor

THE HIGH-PRESSURE cylinder of a three-stage compressor was found to show signs of severe wear, the liner walls being scored and the piston rings and valves becoming pitted and worn in a short time. An examination disclosed a deposit of rust. The source of the rust was finally traced to the intermediate-stage scale trap.

The rust had been carried along with the air and had acted as an abrasive. The trouble was remedied by thoroughly cleaning the inside of the trap and painting it with a pigment made from three pounds of flake iron and one pound of linseed oil which had not been treated with a drier. This protected the steel and prevented further rusting. An additional precaution was taken by keeping the traps well drained. W. E. WARNER.

Brighton, England.

Dual Firing of Boilers—How Successfully Is It Being Done?

FOR MANY YEARS coal and natural gas have been used simultaneously or alternately as fuel under boilers. This condition has existed in territories where natural gas was plentiful and cheap. Coal and oil have also been used simultaneously or alternately, to a lesser extent. The use of natural gas, manufactured gas and oil in this way was, primarily, to permit taking advantage of seasonal decrease in fuel prices, as a simple way to develop more fully existing boiler capacity, and during certain times as the only way to assure adequate fuel supply.

Not much has been said of late about low-grade fuels. The low-grade fuel situation has become dormant, perhaps because of cheaper coal and ample supplies. Or perhaps the use of pulverized coal, forced-draft chain-grate stokers and the underfeed type of stoker with its clinker grinder have helped alleviate the problem of low-grade, high-ash coals. Whether the problem has been solved—or merely postponed—it would seem that the simultaneous burning of low-grade coal with natural or manufactured gas or oil opens up a wider market for these low-grade fuels; or, at any rate, is a simple and easy way out of taking care of peak loads and overloads. Another aspect of the situation that should appeal most strongly to many plants is that by supplementing coal with gas or oil, it becomes possible to eliminate the banked fire. This represents a worth-while saving in many instances. A banked fire consumes real tonnage during the course of a year. The use of oil or gas enables the heat input to accurately take care of the radiation and condensation losses. Liquid and gaseous fuels also enable a rapid steam-up to be accomplished.

From a financial viewpoint, dual firing of solid and gaseous or liquid fuel offers promising returns, enabling the switch to be made from one fuel to the other according to market prices and permitting a boiler to be operated at 100 per cent of rating or even higher with lower stand-by losses. From the engineering viewpoint, a number of interesting problems are introduced, many of which have been solved. The effect of the oil flame or gas flame is to improve the mixing of combustible gases evolved from the solid fuel bed, so producing more rapid combustion and lessening the possible escape of carbon dioxide up the stack while increasing the over-all furnace efficiency and boiler capacity. Tests have shown that evaporation can often be increased 100 per cent by simultaneously burning 40 per cent fuel oil and 60 per cent coal, the percentages applying to the total heat units developed.

The use of oil or gas with the slow-burning, high-ash coals is deserving of wider application and experimentation. Engineers would be interested in knowing how seasonal switching from solid to liquid or gaseous fuel is accomplished, the precautions to be followed, the effect upon refractory life, etc. It has been demonstrated beyond a doubt that furnace turbulence increases combustion efficiency and increases boiler capacity without increasing furnace upkeep cost in anything like the proportion expected due to the more severe service. The use of oil and gas, with their ability to create turbulence, also should point to lower relative furnace upkeep cost as compared with the increased furnace efficiency and capacity.

Where seasonal switching is made from solid to gaseous or liquid fuel, problems are introduced, of course, because of the necessity for protecting the grate when not in use, for shutting off the cold air at the back of the furnace, etc. These are being met. Other problems crop up that have not been mentioned here. To what extent is dual firing of boilers being practiced; what are some of the problems that have arisen; and how have they been solved? The big gain in the consumption of natural gas and the increasing mileage of pipe lines broadens the field for the firing of oil and gas in conjunction with coal, either alternately or simultaneously. Engineers will welcome the facts, financial and technical. Who can furnish them? R. K. LONG.

Chicago, Ill.

Operating Soot Blowers With High-Pressure Steam

IN THE DEC. 24, 1929, number of *Power*, A. D. Duncan tells of boiler tubes being damaged through soot-blower elements slipping and permitting the steam jets to impinge on the tubes. In our plant we have seven bent-tube boilers carrying 215-lb. pressure and 200-deg. superheat and operated at 250 per cent of rating, all equipped with soot blowers.

One of our troubles with soot blowers is that the elements begin to grow after about ten months' service. This growing continues until the nozzles near the end of the element get too close to the edge of the next tube. We then readjust the element so that the jets of steam will not cut the tubes. This can be done about twice, for after the element has grown 1½ to 2 in. it is too long to do any more readjusting without endangering the boiler tubes. It is then taken out and replaced with a new one. We get a maximum element life of three years, but some of them are good for only two years. This would indicate that when inspecting soot blowers it is more impor-

tant to look after the alignment of the holes at the end of the element than just near the head.

Most of the growing seems to take place in the section holding the nozzles. When an element is removed it is thinner in cross-section at the nozzle hole, and the holes where nozzles have dropped out will be elongated. If an element has over three nozzles missing it is best to replace it, as its efficiency is very much reduced.

This trouble occurs at the top of the first pass and in front of the superheater. These are, of course, the hottest positions, but the elements are so located that they are partially shielded from the flames. The foregoing experience has been with the best elements we could procure and has been repeated at least eight times.

Dixon, Ill. DONALD S. MCWETHY.

Recognition Through Licensing

IT WOULD appear that many holding engineering positions are of the opinion that because the nature of the work in which they are engaged does not make it necessary for them to take out professional engineers' licenses the question of licensing is one of special interest to them.

During the past twelve months I have served on committees formed to discuss legislative and other questions relating to the licensing of engineers, and I am of the opinion that those who hold this view are living in a fool's paradise, so to speak.

Although I, personally, am in favor of the licensing of professional engineers, thus putting them on a par with the members of other legally recognized professions, I am willing to admit that there may be a legitimate difference of opinion, and that in many cases this question is of academic interest only, being of no practical importance at all. This statement may be surprising to many readers, but let us look at the conditions.

At the present time there are 26 states that require professional engineers to be licensed, and everything points to an early increase in this number. Canada is following similar lines, as are many foreign countries.

Experience indicates that when a state once decides to regulate a profession the laws or regulations are there to stay, at any rate until such time as they may be superseded by more stringent ones. In this connection, the following facts should be kept in mind:

The licensing laws define the work that must be done by a licensed man, thereby limiting the scope of the work that may be done by an unlicensed man. Both classes, being subject to the laws of their states, are thereby equally affected by the operation of the law.

In spite of the fact that an unlicensed man is affected by the laws governing the practice of engineering, he is legally non-existent as a professional engineer and has therefore no standing in court.

There appears to be a strong tendency on the part of licensed engineers to work for the broadening of the field in which only licensed men can operate. This is quite natural and is in accordance with the tendency in other professions. To protect himself the unlicensed man must either join the licensed ranks or combat this tendency.

As already intimated, engineers are not alone in their endeavor to confine the practice of their profession to qualified men, and it should not be overlooked that whenever the members of one profession obtain the passage of a law enlarging the scope of their own practice or more clearly defining the activities which can only be engaged in by members of their profession, they thereby contract the field of other professions.

Engineering is so broad that it contracts other professions at many points, but there are indications of a tendency on the part of other legally recognized professions to refuse to negotiate with those who are not legally recognized as professional men. There is much to be said for this attitude.

We do not expect the members of the legal or medical professions to recognize unlicensed practitioners of their own profession. And we should not be surprised if there is a tendency on their part to take a similar attitude toward members of other professions and as regards ourselves; especially so in those states that recognize engineering as a profession.

No doubt this tendency will grow, and if the interests of the engineering profession are to be protected it would seem advisable that all those who are qualified should join the licensed ranks.

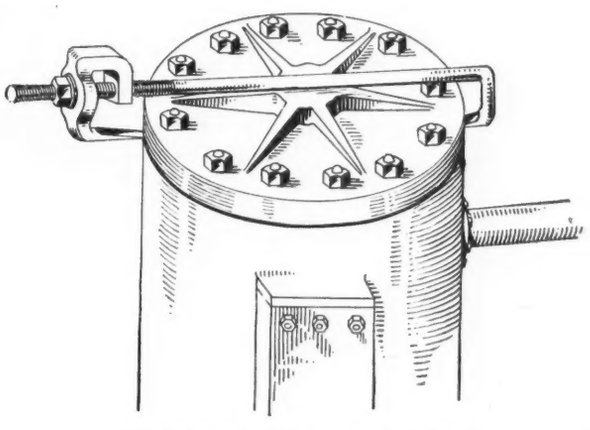
This is not intended as propaganda for the licensing of engineers, but it is intended as a plea to engineers to stop dreaming about an accomplished fact—which even the most ardent objectors admit cannot be done away with—and to adjust themselves to the unavoidable; so that the best interests of our profession may be served. JAMES O. G. GIBBONS.

Newark, N. J.

Use of Home-Made Devices in the Power Plant

THERE has been considerable discussion in past numbers of *Power* in regard to home-made devices. It is apparent that many writers would discourage power plant men attempting home-made kinks in repairs and maintenance. I have been a reader of *Power* since 1912, and for many years a constant contributor on power plant experiences and home-made devices. If I could express in writing my thoughts on this particular subject I would feel that some good had been accomplished, for I would plead like an able lawyer to allow the home-made ideas to continue their freedom.

Several years ago when I was handling the throttles of a 50,000-hp. battleship I used my first home-made device, shown in the accompanying illustration. It was made by the ship's blacksmith. The idea came to me after I had seen a perfectly good cylinder head of a main feed pump cracked by the indiscriminate application of brawn on a



Tool for starting cylinder head

blunt cold chisel with a heavy hammer in an attempt to loosen the head. The little device shown worked splendidly and was used frequently by the boys in the plant. Some may say that it is no good, that they have cap screw holes tapped in modern machinery for this purpose—but that is beside the point.

I would never discourage any man from creating. He may not be able to compete with laboratory engineering developments or turn out the quality of parts that the manufacturer does, but at least he has initiative and some inventive ability, and who knows how many of our highly useful inventions have come from some crude home-made device.

Furthermore, I do not believe that the business of the manufacturers of power plant equipment has ever suffered from any over-enthusiastic development of home made equipment. In my many years in power plants I have never known of anyone attempting to create something that could be purchased more cheaply. I say this cautiously, for the reader must remember that many of the devices described in *Power* during my 18 years as a reader have been made of odd parts and in time that would not be directly chargeable to the device.

I wish that contributions of this interesting sort were greater. Let's have them "Right Out of the Plant."

West Concord, N. H. CHARLES H. WILLEY.

Formula for Calculating the Sensible Heat in Dry Flue Gas

THERE appeared in *Power* for Dec. 24, 1929, several answers to the question: "What temperature should t (as used in the formula for calculating the sensible heat contained in the dry flue gas per unit of fuel burned) equal—that of the boiler room or of the outside air and why?"

No fault is to be found with the answers as they have stated the correct temperature to be taken for t, but it appears to me that an error exists in the formula or that a necessary value has been left out of the formula as contained in the question, although none of the contributors has mentioned such, probably owing to the fact they were wholly interested in advising the correct temperature to be taken for t.

The error I refer to is weight of gas. It seems to me that in solving for B.t.u. in the dry flue gas per unit of fuel burned the weight of fuel must be taken into consideration and become a part of the formula, and that the value W should represent something more than the mere weight of gas. For instance: It could represent pounds of dry flue gas escaping per hour; then the formula for calculating the dry flue gas loss in B.t.u. per pound of fuel would be—

$\frac{W \times H \times (T - t)}{F}$ = B.t.u. contained in the dry flue gas per pound of fuel burned,

where W = Pounds of gas escaping per hour,
H = Specific heat of the flue gas,
F = Pounds of fuel burned per hour,
T = Temperatume of the flue gas,
t = temperature of air entering furnace.

We can shorten the formula by making W equal pounds of gas escaping per pound of fuel burned and thereby eliminate the unit of time.

Then the formula becomes—

$W \times H \times (T - t)$ = B.t.u. contained in the dry flue gas per pound of fuel.

I think that the term dry flue gas loss is more appropriate than sensible heat contained in the dry flue gas, as it is really the loss that we are interested in. So we will say that the formula for calculating the dry flue gas loss in B.t.u. is:

$WH(T - t)$ = B.t.u. per pound of fuel burned, where the values are the same as previously mentioned for this formula.

The value of H varies slightly with the temperature and composition of the flue gas, but as nitrogen constitutes more than 50 per cent of the flue gas and the table of specific heat of substances shows that of nitrogen to be 0.24, we will use this for the value of H. The correct value of W is the most difficult to obtain. To calculate this we need to know the pounds of air entering the furnace per pound of fuel burned to determine the weight of gas.

Assume that fifty per cent of excess air is being admitted to the furnace for combustion. Then as 1 lb. of fuel requires about 12 lb. of air for complete combustion, the air entering the furnace will be $1.5 \times 12 = 18$ lb. of air entering the furnace per pound of fuel. Burning 1 lb. of carbon to CO_2 requires 2.66 lb. of oxygen, so in burning 1 lb. of carbon to CO_2 there is 1 lb. of carbon plus 2.66 lb. of oxygen, equal to 3.66 lb. of CO_2 in the dry flue gas per pound of fuel.

The amount of oxygen contained in the air is 23 per cent by weight, and in admitting 18 lb. of air per pound of fuel we would have $0.23 \times 18 = 4.14$ lb. of oxygen admitted to the furnace per pound of fuel, but as 1 lb. of carbon requires only 2.66 lb. of oxygen for complete combustion, we would have $4.14 - 2.66 = 1.48$ lb. of free oxygen in the dry flue gas per pound of fuel.

The nitrogen contained in air is 77 per cent by weight, so by admitting 18 lb. of air per pound of fuel we would have $0.77 \times 18 = 13.86$ lb. of nitrogen in the flue gas per pound of fuel.

Then—3.66 lb. of CO_2 plus 1.48 lb. of oxygen plus 13.86 lb. of nitrogen equals 19 lb. of dry flue gas escaping per lb. of fuel burned.

Nitrogen is an inert gas, so the same weight of this element that is admitted to the furnace is discharged with the flue gas.

We will assume the temperature of the dry flue gas T equals 500 deg. F. and temperature of air entering the furnace t equals 100 deg. F. Then our formula $WH(T - t)$ = dry flue gas loss in B.t.u. becomes: $19 \times 0.24 \times (500—100) = 1824$ B.t.u.

Assuming the fuel burned contains 14,000 B.t.u. per pound, the stack loss in percentage is

$$\frac{(1824)}{(14000)} \times 100 = 13.02 \text{ per cent}$$

I believe that all will agree that the error I have mentioned exists in the formula as contained in the original question, and that the weight of gas must be designated as a definite unit to obtain the B.t.u. lost per unit of fuel burned.

Of course the weight of gas in the formula will be readily comprehended by the older and more experienced engineers, but to the beginner in such problems, just merely weight of gas would not be readily understood, and he would be lost as to what quantity of gas he is to find the weight of in solving the problem.

Brooklyn, N. Y. HERBERT S. ENDER

THE AVERAGE CONSUMPTION of coal per kilowatt-hour, for central stations in the United States, is now 1.65 lb.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

PUMPING WATER OVER A HILL—*A town wishes to take water from a reservoir in the hills and pump it over a hill to a tank at a much lower level. The tank will then supply water to a town. The tank is to have a capacity of 500,000 gal. and when full the water level will be 90 feet above the town elevation.*

The tank, on a hillside, is 12,000 ft. from the reservoir. A pumping station will be located near the reservoir, requiring a suction lift of only 12 feet at the centrifugal pumps. The maximum hourly demand will be 1,000 g.p.m., so that a 10-in. line will be amply large.

Three thousand feet from the reservoir the elevation of the pipe line is 135 ft. above the reservoir level. The line then goes down grade to the tank, a drop of 190 ft., or 55 ft. below the reservoir's level. The length of the pipe from the high point of the intervening hill to the tank is approximately 9,000 ft.

What is the starting and operating heads on the pumps. There will be two pumps, each of 1,000-g.p.m. capacity.

M. J. D.

The starting head will be the suction lift plus the elevation head from the pump to the peak of the line plus the friction head loss from the reservoir to the peak point, or

$$H_s = 135 + h_f \text{ ft.},$$

in which H_s = starting head
and h_f = friction head in ft.

The friction head loss h_f may be calculated with the usual Darcy formula,

$$h_f = \frac{fL}{d}\left(\frac{v^2}{2g}\right), \text{ in which}$$

f = friction factor,
L = length of pipe in ft.,
d = diameter of pipe in ft., = 10 in.
v = velocity of water ft., per sec.,
$2g$ = 64.3

The velocity of the water in the pipe line, assuming the line running full, will be

$$v = \frac{Q}{A} = \frac{1{,}000 \times (8.33)}{60 \times (62.4) \times (0.833)^2 \times 0.7854} = 4.1 \text{ ft. per sec.}$$

Assuming clean 10-in. wrought-iron pipes, the friction factor will be 0.022, and

$$h_f = \frac{0.022 \times 3{,}000}{0.833}\left(\frac{4.1^2}{64.3}\right) = 20.5 \text{ ft.}$$

Then the starting head will be,

$$H_s = 135 + 20.5 = 155.5 \text{ ft.},$$

neglecting other friction losses due to valves and bends in pipes. These losses are usually so small compared to the friction losses that it is customary to neglect them. They would amount to 2 or 3 ft. in this case.

To start the water flowing over the peak point the pumps would have a starting head of 155.5 ft., to possibly 158.5 ft.

After the water gets over the peak in the line and runs down to the tank there will be a siphon action and the line will no longer run full of water.

The operating head H_o will then be the elevation head from the reservoir minus the siphon head of 34 ft. plus the friction head to some point C that is 34 ft. below the peak point in the line. The point C is 5,000 ft. from the reservoir in this particular case.

Then the operating head is

$$H_o = 135 - 34 + h_{f_2},$$

where h_{s_2} is friction loss to C.

Therefore

$$H_o = 101 + \frac{0.022 \times 5{,}000}{0.833} \times \left(\frac{4.1^2}{64.3}\right) = 101 + 34.2 = 135.2 \text{ ft.}$$

An operating head of around 138 ft., including other friction losses, compared to a starting head of about 158 ft., will cause the pump designer some trouble. The characteristic head curve for centrifugal pumps is a dropping one as the capacity increases.

What would happen is that the pump would not deliver 1,000 g.p.m. against the higher starting head, but it would get up to capacity as the line filled and the head dropped off.

This type of installation is fairly common, but never entirely satisfactory, as air-relief valves must be installed at the peak and corrosion of the line is bound to be caused by entrained air. It might even be necessary to install an air pump at the peak to remove the air.

The figures used and the calculations made are all approximate, as the point being made is to show the method to be used rather than detail calculations.

Although the calculations given above show that theoretically the operating head will be less than the starting head on account of the siphon action, yet practically the line would have leaks in it so that air would get in and break the vacuum. The operating head would therefore actually be the starting head and the pump would be designed accordingly.

The problem and answer were supplied by Prof, W. J. Dana, N. C. State College, and are published here, as like problems occur from time to time. —L. H. M.

PREVIOUS QUESTION

DISCUSSED BY READERS

THE QUESTION

OVERHEATING of a 4,000-kva. oil-insulated water-cooled transformer appears to be caused by fouled cooling coils. The cooling system recirculates water through a cooling tower and undoubtedly has a high salt concentration. What means may be employed to clean the coils without removing them? The coils are of brass. K. T. S.

WE HAVE two transformer banks of three units each. These transformers are water-cooled and oil-insulated, and each is rated at 225 kva. 2,300 to 22,000 volts. They have been operating since 1914. About six months ago the flow of the circulating water became sluggish and the transformer temperature high. The water through the coils is normally pure, derived from a small pond in a creek near the plant, which is 960 ft. above sea level.

In September, 1928, this island was visited by the worst storm on record, and practically all waters ran contaminated with decayed vegetable matter for some months afterward. This was primarily the cause of the trouble in the transformer cooling coils, which appeared about eight months after the storm.

There is an air compressor in the plant which can supply air at 125 lb. pressure, and we tried pumping air through the coils, but without satisfactory results. We then connected a hand pressure pump, normally part of a steel-bar hydraulic cutter used on construction jobs for cutting reinforcing steel bars, to the transformer cooling coils. The high-pressure water supplied by

the pump effectively cleaned the coils. We kept the two-gallon reservoir of the pump filled while it was being worked.

The pressure inside the coils would momentarily rise to between 200 and 300 lb., then it would drop to zero, gradually building up again until at the end of 15 min. the mud plug came out at the coils' discharge. The mud, sand, clay and vegetable matter that came out of each coil was collected. This material amounted to about ¼ of a cubic foot in each coil.

JUAN FREIXAS GONZALEZ,
Engineer,
Porto Rico Irrigation Service.
Guayama, Porto Rico.

I DO NOT KNOW if the transformer has more than one coil or not, but will assume it has three separate cooling coils. One coil may be cut out at a time on light loads and cleaned, in the following manner:

Take a wooden barrel and connect a small cast-iron centrifugal pump about 6 in. from the bottom. Put in the barrel about one-third more water than the coil will hold. Bring the discharge from the coil back into the barrel, start the pump and slowly add muriatic acid until about a 10 per cent solution is obtained. Sometimes a little more acid is needed, as it becomes neutral in dissolving scale. The strength of the solution in the barrel may be tested by dropping pieces of scale into a small amount of the solution. The cleanness of the coils can be determined by the amount of foam and sludge coming from the discharge pipe.

Always be sure to run clear water through the coil as soon as the cleaning is finished. If a small cooling tower is being used, acid can be injected in the suction pipe.

I have found this method to be the fastest way of cleaning. Care must be taken in handling the acid and not let it splash on the hands or clothes. If a rubber apron and boots are handy use them. H. H. FINCH,
Aberdeen, Wash. *Chief Engineer,*
Grays Harbor Railway & Light Co.

SLUDGE can be removed from the inside of the cooling coils by compressed air. The water and air lines should be so interconnected that either water or air may be passed through the coils. Shut off the water and allow compressed air to flow through the cooling coils until the air at the discharge gets warm. Then close the air valve and let the water flow in until it comes clear at the discharge. Repeat until the water is clear at the discharge.

The compressed air circulating through the cooling coils evaporates the moisture in the sludge, causing it to crack and scale off the coils. If the air and water cycle is repeated a sufficient number of times the coils can be cleaned to where the temperature of the transformer will be normal.

C. V. CALDWELL.
Fairmont, W. Va.

INSTRUCTIONS for the "Care and Operation of Transformers," published by the National Electrical Manufacturers' Association, Graybar Building, New York City, gives the following recommendation for removing scale from transformer cooling coils:

In the case of water-cooled transformers, the rate of flow should be checked from time to time and if it is found to have diminished the cause should be looked for and remedied. The most frequent cause of clogging of cooling coils is the presence of air in the water, resulting in the formation of a scaly oxide.

Scale and sediment can be removed from cooling coils without taking them from the tank. Both inlet and outlet pipes should be disconnected from the water system and temporarily piped to a point away from the transformer where the coils can be filled and emptied safely. Special care must be taken to prevent any acid, dirt or water from getting into the transformer.

All the water should be blown or syphoned from the cooling coils, which should be then filled with a solution of hydrochloric (muriatic) acid, specific gravity 1.10. (Equal parts of commercially pure concentrated hydrochloric acid and water will give this specific gravity.)

It may be found necessary to force this solution into the coils. When this is done, one end of the coils should be partially restricted, so that the solution will not be wasted when the coils are full. After the solution has stood in the coils about an hour, they should be flushed out thoroughly with clean water. If all the scale is not removed the first time, the operation should be repeated until the coils are clean, using new solution each time. The number of times it is necessary to repeat the process will depend on the coils' condition, though ordinarily one or two fillings should be sufficient.

As the chemical action that takes place may be violent and may often force acid, sediment, etc., from both ends of the coils, it is well to leave both ends partially open to prevent abnormal pressure.

M. A. WALKER.
Cleveland, Ohio.

A Question for Our Readers

WHEN using a magneto to make ground and open circuit tests sometimes the indications obtained are the opposite from what they should be. For example, I have had the magneto fail to ring through the shunt field winding of a motor when the winding circuit was complete. In other cases the magneto has indicated a dead ground, when the equipment tested by other means showed a high insulation resistance. Why do I obtain wrong indications with the magneto?

C. M.

Suitable answers (of not over 200 words) will be paid for and published in the Feb. 18 issue.

IT IS APPARENT that the water used for cooling the transformer contains foreign matter in solution, such as lime and carbonates. These impurities, when the water becomes heated in passing through the coils, are precipitated as scale, which in addition to being a poor conductor of heat, chokes the flow of water.

The scale can probably be removed by draining the water coil, plugging it at one end, and filling it with hot water to which has been added ½ lb. of sal soda (ordinary washing soda) per gallon of water. Allow this to remain in the coil for a short period, then drain and flush with clean water.

In case this treatment does not thoroughly clean the coil, a solution made by adding one pint of muriatic acid to each gallon and one half of cold water should be poured into the coil and allowed to remain for five or ten minutes. Then thoroughly drain and flush the coil to remove all traces of the acid.

To prevent further formation of scale, a softener should be added to the water used in the cooling system.

EDWARD B. ALEXANDER.
Lockport, N. Y.

THE BEST WAY to clean the transformer cooling coils is to close their lowest ends and fill them with hot water. At the other ends of the coils connect a steam nozzle and turn on the steam to agitate the water. After about five minutes of this treatment remove the plug from the coils and blow the water out with steam. This treatment will remove much of the sludge. Two applications should clean the coils sufficiently to bring them back to normal. I have always found this treatment effective. Steam is much more efficient than compressed air for blowing out coils. W. E. WARNER.
Brighton, England.

ABOUT the only way to keep the transformer coils clean is to use treated water. First, thoroughly clean the coils, and drain the water from the cooling tower, after which the tower should be cleaned. Then fill the tower with water treated with a chemical compound to neutralize its scale-forming properties.

Have a sample of the water analyzed to determine the chemicals that should be used. A chemist will recommend the chemicals and the proper quantities for treatment. JOHN L. WHITE.
Lima, Ohio.

WELDING RULES LIBERALIZED

for Pressure Vessels

IT WAS ANNOUNCED some months ago in *Power* that the Boiler Code Committee of the A.S.M.E. had under consideration revisions of the unfired pressure vessel code that would greatly broaden the field for fusion welding. These proposed revisions were published in the January number of *Mechanical Engineering*.

No attempt will be made here to reproduce the revisions literally or completely. It is worth while, however, to point out their more significant features.

The code before revision did not permit the application of fusion welding to air vessels whose diameter exceeded 20 in., whose length exceeded three times the diameter, or whose pressure exceeded 100 lb. per square inch. In other vessels welding of circumferential joints was permitted when the inside diameter did not exceed 48 in., or when it did not exceed 72 in. where at least 75 per cent of the load on a flat head was supported by tubes or through stays extending from head to head.

Significant provisions of the revised code increase the 20-in. diameter limit mentioned for air vessels to 60 in., and the limiting pressure to 200 lb. per square inch provided the temperature does not exceed 250 deg. F. Of equal importance is the increase in permissible unit stress. The old code states that the stress at right angles to the direction of the weld shall not exceed 5,600 lb. per square inch in any case. The revised rules will permit maximum unit working stresses at right angles to the direction of the joint, as follows: For butt double-V longitudinal welds, 8,000 lb.; for butt single-V girth or head welds, 6,500 lb.; for double full fillet lap or girth welds, 7,000 lb.; for spot or intermediate girth or head welds, 5,600 lb.

It is clear that this increase in limiting diameter and in permissible working unit stresses enormously improves the economic position of welding as applied to pressure vessels. Higher unit stresses, in particular, have a profound influence on manufacturing costs.

It should be particularly noted, however, that none of these increases is applicable, except where the manufacturer abides fully by the "recommended procedure for fusion welding of pressure vessels," which is made a part of the revision. The preparation of this recommended procedure, in which the Boiler Code Committee was assisted by the American Welding Society, was a difficult task. There are many variations in the processes of fusion welding, the main processes of oxy-acetylene welding, carbon arc, metallic arc, etc., being broken down into as many variations as there are manufacturers. Obviously, it would not be proper for the code committee to specify any single welding process. Nor, on the other hand, would it be practical to lay out innumerable procedures for all the various processes.

The subject matter of the recommended procedure is covered in seven sections, as follows: (1) Materials; (2) Design; (3) Construction; (4) Qualification of Welders; (5) Supervision; (6) Inspection; and (7) Testing.

Firebox or flange quality steel is specified for shell, heads, etc. Steel castings and commercial nozzles are permitted for manholes and other connections only where the material has proved to be of good weldable quality. Electrodes, as well as welding rods for gas welding, are required to conform to certain American Welding Society specifications.

Liberalized rules for the welding of unfired pressure vessels have been released for comment by the Boiler Code Committee of the A.S.M.E. The limiting diameter has been increased to 60 in., and limiting pressures to 200 lb. per square inch. Permissible unit stresses (at right angles to the direction of the weld) have been increased from 5,600 lb. per square inch, to a maximum of 8,000 lb. for butt double-V longitudinal welds. These increases are all conditional upon the adoption of a recommended procedure for the welding.

Under the heading of "design" are general rules or cautions. It is suggested that where plates of unequal thickness are butted the thicker plate should in some manner be thinned at the edge. The manufacturer is asked to avoid welds at points where bending stresses are concentrated, such as at the knuckles of dished heads.

Under "construction" the importance of the preliminary removal of scale, rust and dirt is stressed, as well as the provision of the proper initial spaces between plates. There are no limitations as to the preparation of the edges to be welded, except that for the longitudinal joints of cylindrical vessels double-V type welds must be applied. Single-V welds reinforced at the root are held to meet this requirement if properly constructed. The importance of fusion and penetration are constantly emphasized.

Before welding the second side of the double-V, it is required that all scale and metal that has run through from the weld on the first side be removed by chipping, grinding or otherwise.

Provision is made for qualifying welders. Their test consists of welding together in a flat position two plates of the same material and thickness as that to be used in the tank under consideration. Where the welder is required to make fillet welds, butt welds over § in. thick or welds in other positions than in the flat, he must qualify in the given class of work. The test plates are cut into strips by a gas torch, or otherwise, machined, and reinforcements are ground off. To qualify the welder, the result must show an average strength of at least 45,000 lb. per square inch, with no test piece giving less than 42,000 lb. If these results are not attained, the welder may be given a duplicate test.

Under the heading of "supervision and local inspection in the shop" it is made clear that it is the duty of the management of the welding shop to provide such supervision and local inspection as will make sure that the requirements of the code for unfired pressure vessels, and also those of the recommended procedure, will be carried out on any welded pressure vessels to be stamped as provided for in the code.

The manufacturer is also required to arrange for inspection of the pressure vessels during construction by an inspector employed for this purpose, who shall not be in any way connected with the management of the shop performing the welding, but shall be a state or municipal inspector, or an inspector regularly employed by an insurance company engaged in boiler or pressure vessel inspection work.

It shall be the duty of the inspector to check construction of the vessel to make sure that the provisions of the recommended procedure are carried out. He checks materials, markings, gagings, formation of defects during fabrication, etc. After the shell is welded the inspector is required to inspect the weld from the inside and the outside of the shell, and record their appearance. Before examining a weld, the outside and inside of a shell shall be struck all along the length of the weld with a hand hammer to break loose the scale. A wire brush shall also be used to clean the surfaces. The usual hydrostatic test, accompanied by hammering, is required.

As already indicated, these revisions are proposed rather than finally accepted. Following the usual procedure, the code committee has published them. After 30 days have elapsed, to afford full opportunity for criticism and comment, modified rules as finally agreed upon are presented to the council of the society for approval as an addition to the boiler code.

STATE SUPERVISION OF DAMS

Discussed at Civil Engineers' Meeting

THE FAILURE of the St. Francis dam in California and the conditions under which it failed have centered a great deal of attention on closer supervision of the design and construction of such structures by a governmental body. At the 75th Annual Meeting of the American Society of Civil Engineers, a paper "State Supervision of the Design and Construction of Dams," by A. H. Markwart, vice-president of the Pacific Gas & Electric Company, was presented that outlined how such supervision should be exercised. After reviewing the necessity for supervision and the legislation enacted for this purpose in the United States and other countries, the characteristics of the best type of supervision were given as follows:

Characteristics of Supervision

It is apparent that the failure of the St. Francis dam has caused governmental agencies concerned with the approval of dams to be considerably more exacting than they had been hitherto. In view of the apprehension engenered, it is not improbable that the tendency will be to require dams to be constructed stronger than actually necessary. Such excess strength can be had only from capital expenditures greater than have been required in the past, which in the case of hydro-electric power will impose even greater burdens than those which now obtain. Water powers are constantly growing more costly, and one of the factors having much to do with this is the increasing state and federal authority over water and water powers. It is conceivable that if this continues, water powers will finally become too costly to develop. Even now a water power must be most favorably situated to compete with the modern highly efficient steam plant.

Engineers, and particularly civil engi- organizations interested in the building of dams should, however, take a rational, rather than an opposed, view on legislation, because there appears to be some justification for governmental control. They should determine for themselves the kind and extent of legislation desired. They should study the problem with a view to directing public opinion along lines not subversive of the best public interests. They should discourage anything in legislation that would tend to hamper the fine progress in the development of dam construction which has characterized the art.

As to the statute itself, it would seem desirable to foster the maximum use of existing governmental machinery, state engineers' offices for administration and the courts for enforcement, rather than to create new agencies, except as providing for the services of consulting experts in major cases.

Consulting boards acting during the design and construction periods only are not sufficient. Operation and maintenance must be checked by the routine inspections of some standing authority, after the consulting boards are discharged.

The statute should, in so far as possible, confine itself to the basic principles, leaving the details to be covered by regulations and rules which may be formulated by the state engineer or other administrator, as occasions demand. Few limitations should be placed upon the supervisory agency as to the technical aids which it may employ in the discharge of its functions. By these means necessary revision could be more readily effected than would be possible through legislation, which otherwise would be required.

Furthermore the statute should require promptness of action in the matter of approvals, either from state engineers' offices or other supervisory bodies which may be charged with its administration, in order that there may be no undue delay in gaining decisions on proposed construction. For instance, the Idaho law requires that approval be either given or refused within 45 days.

It is now generally recognized that the design, construction and maintenance of dams for power development and other projects should be under state supervision. Some such control is already exercised. How to make this supervision most effective without placing an unnecessary burden on the owners of the projects, and how to insure safe structures were considered during the Power Division Session at the American Society of Civil Engineers' recent annual convention in New York City.

The elements that should characterize the best type of supervision will fall naturally into certain groups which may be discussed more or less independently, bearing in mind that they all should have the common but limited objective of safeguarding life and property. Any governmental regulation which does not conduce to that end is needless and extraneous.

In conclusion, it was Mr. Markwart's suggestion that the general subject of dams and the kind of legislation relating to supervision and control which will safeguard the public and at the same time will not impose unnecessary delay and excessive costs would be a valuable subject for committee action by the American Society of Civil Engineers. It would perhaps be timely for such a committee to outline a type of legislation that is best for the states to enact, since the conditions in the different states are not so diverse as to preclude the successful operation of a uniform act.

Discussion

Whether state supervision of dams was desired or not, it was going to come was a common opinion expressed in the discussion of the paper. A number of the states already exercise such supervision, and the list is increasing. Aside from this, the general feeling was that the proper kind of state supervision of dams is desirable and should be encouraged. As no group is better equipped to know what form this supervision should take than the civil engineers, they should endeavor to provide the necessary information to state legislative bodies that will obtain the desired control over the design, construction and maintenance of dams.

It was pointed out that the design and construction of a large dam should not be left to the judgment of any one engineer, no matter how capable he may be. Critical defects in dams that have failed could have been avoided in many cases by proper supervision.

Supervision over small dams was considered of equal importance to that of large structures. Usually when large dams are involved the owners employ the most competent engineers. But this is not always true of those building small dams. Furthermore, the danger from the failure of a small dam in a thickly settled district may be greater than that from a large one away from human habitation.

Considerable attention was given to a code for dam construction. There was a general opinion that a satisfactory code could not be devised in the present state of the art.

Although it was generally agreed that state supervision of dam design, construction and maintenance was desirable, it was not evident how best to obtain this end. A motion was made and carried empowering the Executive Committee of the Power Division to appoint a committee to study the problem.

Chicago Operating Methods Discussed at Boston Meeting

Foresight is the Key to Continuous Economical Operation, Says Alex. D. Bailey in A. S. M. E. Address

THE "SIXTH SENSE" by which power plant operators are supposed to make correct decisions in emergencies is a myth, according to Alex D. Bailey, superintendent of generating stations for the Commonwealth Edison Company, Chicago. Mr. Bailey, who discussed operating problems last Wednesday evening at a meeting of the Boston section of the A.S.M.E., said that painstaking, long-range planning, rather than some mysterious capacity, is the secret of continuous and economical operation. His address, which followed a dinner held at the Engineers Club, revealed Chicago's outstanding achievements in the field of plant and system operation and analyzed their causes. Mr. Bailey was presented by I. E. Moultrop of the Edison Electric Illuminating Company (Boston) pioneer in American high-pressure plant development. The following is a brief summary of the most significant points brought out by Mr. Bailey.

Chicago's last major shutdown occurred 25 years ago, when the Harrison Street plant failed and put the city in darkness for two and one-half hours. In the quarter century since that event the peak load has increased from 39,000 kw. to 1,039,000 kw., while the drudgery, uncertainty and profanity of the early days has been largely eliminated by intelligent, long-range planning.

Plant Layout Big Factor in Service and Economy

In good operation continuity and quality of service must be the first consideration. After that comes economy. The planning of good service must start with the design. Quality of service and obtainable economy are largely fixed by the layout of the plant.

The plant investment runs from 30 to 50 per cent of the entire system investment and the designer must take care not to burden the operator with unduly large fixed charges. He must balance first cost and operating charges with the greatest care.

The designer can do much to keep down investment, while insuring continuous operation, by intelligent planning of reserve capacity.

The "sixth sense" by which operating men are supposed to meet emergencies is a myth. The man who depends on "hunches" generally goes wrong. Studied anticipation of all possible emergencies is the only safe way to avoid most of them and handle those that do occur with the least possible disturbance of service.

Automatic equipment is finding increasing application. With it comes increased complexity and a warning not to go too far in this direction.

$1,000,000 A Month for Fuel

Next to reliable service comes economy of operation, in which the chief factor is fuel cost. Crawford Avenue station, with a capacity of 400,000 kw., burned 1½ million tons of coal last year, at a cost of $5,500,000. The fuel cost of the Commonwealth Edison system was over $1,000,000 per month. The expenditure of these huge sums is the responsibility of the operator.

Being dependent on independent railroads for final delivery of coal to Chicago, the Commonwealth Edison safeguards the supply of raw energy —coal—by providing 40 to 60 days' supply at each plant. One plant stores 170,000 tons. These supplies are increased when emergency threatens.

Many outlying plants, some with much lower fuel costs than those in the Metropolitan district, are tied in with the Chicago stations.

It has been found profitable to throw a larger portion of the load on plants, such as Powerton, where fuel costs are very low. The old idea that it is cheaper to transport coal than electricity is breaking down. At present all increases in capacity are being made in the outlying plants.

Plant and System Outputs Budgeted

System and plant outputs are carefully budgeted on a yearly basis. Near the close of each year the statistical department furnishes the operating department with a statement of the predicted system output for each month of the following year. This is then broken down by weekdays and holidays. The final result is seasonal daily system load curves. The load system is then allocated to individual stations in a way that will insure maximum system economy consistent with reliability and with periods provided for inspections and overhauling. From the resulting individual curves each station makes its own budget to cover fuel, labor and other costs. Results often check these budgets within 1 per cent.

In addition to these charts, each station is provided with a chart showing how much load it should carry for any system load. This is used in connection with a system load meter in each station. Individual station meters in the load dispatcher's office enable him to see that each plant is following its schedule.

It is a fixed policy of the Commonwealth Edison Company to maintain a "running reserve"—units actually turning in service—at least equal to the largest unit in operation in the system. This provides an instantaneous reserve against breakdown and also against sudden storm peaks.

Electric Clocks Necessitate Closed Frequency Control

The general sale of electric clocks placed a new burden on the operator, but the resulting demand for better frequency control has provided a blessing in disguise, because close frequency regulation is also essential to the operation of large systems of interconnected plants. The frequency is now maintained within 1/20 cycle and within 2 seconds of observatory time.

Provision is made for taking boilers and turbines off the lines at definite intervals for inspection, cleaning and repair, thus forestalling trouble.

In recent years research by manufacturers and users has done much to promote reliability. Metals, refractories and feed water have all been studied with great benefits.

Improved Working Conditions Attract Better Men

Cleaner plants, shorter hours and better pay have attracted better men to the job of operation. With adequate training these men are raising plant operation to new levels of reliability and economy. With this has come a rapid improvement in safety.

The present caliber of personnel is indicated by the fact that only three mistakes—none serious—were made last year in 88,000 switching operations.

In the final analysis, good operation all comes down to adequate preparation—planning for things before they happen.

Discussing Mr. Bailey's paper, Mr. Moultrop stressed the importance of continued co-operation between designer and operator. He pointed to the policy of the Edison Electric Illuminating Company that requires complete agreement between designers and operators on all installations. This, the speaker said, means team work and better results.

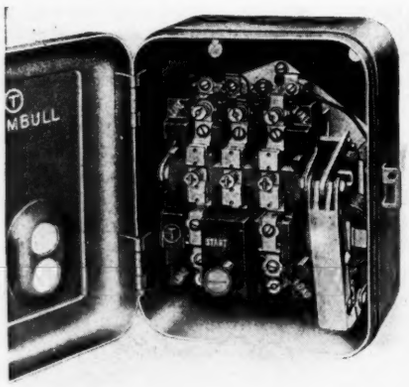
What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Magnetic Switch for Across-the-Line Starting

INTERRUPTING CAPACITY and ease in wiring are among the features embodied in the type M-7½ magnetic switch for across-the-line motor starting put out by the Trumbull Electric Manufacturing Company, Plainville, Conn.

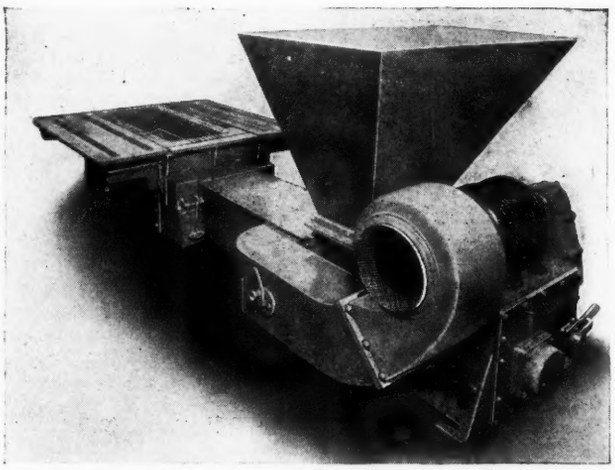
It is of a design providing thermal protection against overload or damage due to phase failure. Regulation may be local, local-and-remote or automatic with the change of one connection on the control terminal. Duo-break control provides high interrupting capacity and reduces the arc to 1/20th of the usual break construction, it is claimed. Another feature is compact contact construction, permitting the starter to be inclosed in a box 6½ in. wide, 8½ in. high and $4\frac{1}{16}$ in. deep. The interchangeable heater elements are removable from the front. Line and load connections are straight through.



View of starter with cover open

Electrically Operated Self-Contained Stoker

THE SMALL STOKER illustrated is a junior-size underfeed unit that can be applied to practically any standard make of heating or power boiler in sizes from 100 to 1,000 sq.ft. of heating surface. It is readily installed under existing boilers where hand-fired grates are to be replaced by a mechanical stoker.



Small motor-driven underfeed stoker with direct-connected forced-draft fan

When applied to existing boilers, the original boiler front and firing doors need not be disturbed, it being only necessary to provide enough clearance space below the existing dead plate to get the lower part of the stoker under.

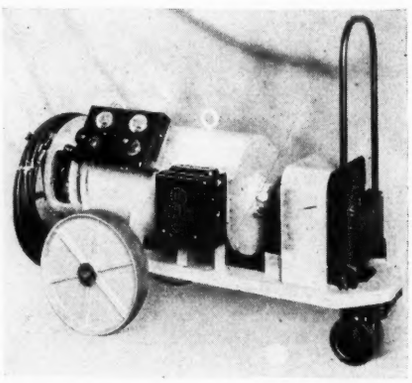
This stoker, put out by the Combustion Engineering Corporation, 200 Madison Ave., New York City, is an electrically operated self-contained unit, consisting, in the main, of a large coal hopper, a conveyor screw, a motor drive, a variable-speed gear, a forced-draft fan, air-admitting tuyeres, and dead plates. Its fuel-feeding capacity is 50 per cent in excess of maximum rated fuel-burning capacity. The stoker body is self-supporting and is entirely independent of furnace brickwork. It is shipped completely assembled ready for installation.

Arc-Welding Generator

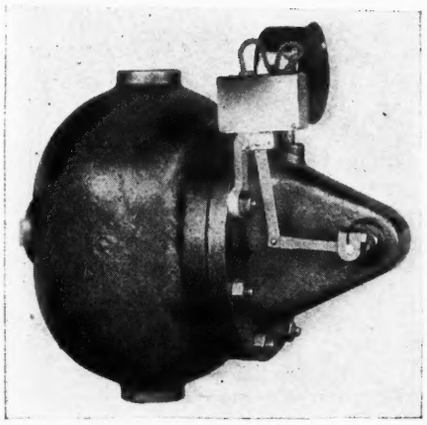
TO SUPPLY current for the "Carb-O-Flux" arc-welding process, which is a combination of a carbon welding arc and a fluxed wire or rod, the generator illustrated has been brought out by the Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill. The process is applicable to mild steels, aluminum, copper, and some alloy steels.

The difference between this process and that employed by the straight carbon arc is that the Carb-O-Flux when applied to steel pulls off from the hottest spot on the deposited metal, whereas the straight carbon arc tends to seek the colder edges. It is claimed that although there is ordinarily a 40-volt drop across the regular carbon arc, there is only a 20-volt drop across this arc, which necessitates the liberation of less heat. The tendency to burn through on thin sheets is therefore reduced.

The generator is available for alternating-current, three-phase, 60-cycle, 220- or 440-volt circuits, but it can be furnished for other drives, such as belt drive from a line shaft, for direct-current operation and alternating-current operation from 25- and 50-cycle circuits, as well as for two-phase circuits. The accessories consist of a cable with lugs for attaching an electrode holder, a ground clamp, and a helmet equipped with proper lenses.



Welding generator for "Carb-O-Flux" process



Float control for condensation systems

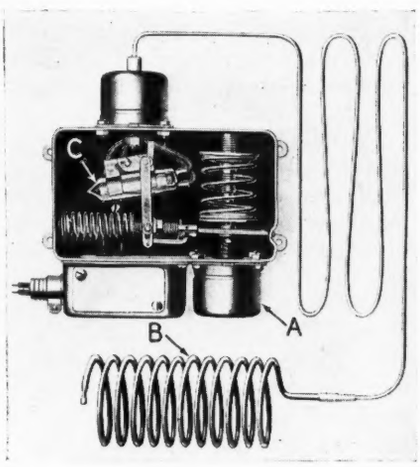
Pump Float Control Unit

THE ACCOMPANYING ILLUSTRATION shows the McKee float control unit now being put out by the Eclipse Fuel Engineering Company, Rockford, Ill., for use with condensation systems and boiler pump units.

The unit consists, essentially, of a short-arm float incased in a cast-iron body or chamber and an external positive-contact switch fastened to the flange at the top of the float chamber. Connection between the float and switch is made by a horizontal shaft and links, as shown. Pipe connections are provided at the top and bottom of the float chamber for connecting it to the boiler or condensation receiver at the proper level.

Dual Control for Unit Heaters

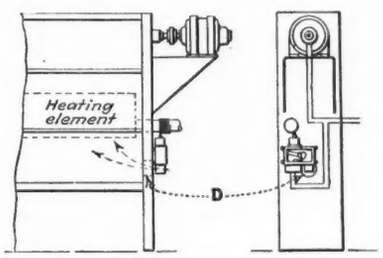
IN THE OPERATION of unit heaters some type of automatic control is essential if overheating is to be avoided and the most economical use of the steam is to be made.



Unit heater dual control with cover removed

The model DMS mercoid control put out by the American Radiator Company, 40 West 40th St., New York, N. Y., combines two instruments in one: automatic control of room temperature by starting and stopping the fan motor according to changes in air temperature, and an automatic cut-off which stops the motor, or prevents it from starting, in case the heating surface of the unit is cold.

Two thermostatic elements are used, each operating the same mercoid switch. The lower element *A* is actuated by the temperature of the air, which is drawn over it by the fan. With an increase in air temperature the element *A* tilts the switch *C* and opens the motor circuit. A decrease in temperature causes the motor to start. The upper element is equipped with a flexible thermostatic tube, four feet of which is wound around the condensation or drip line. As long as this pipe is cool, the element *B* locks the switch *C* in position with the circuit broken, and change in air temperature cannot start the motor. When steam fills the heating surface and the drip pipe warms to 160 deg. the upper element expands and releases the lock, allowing the lower element *A* to start and stop the motor to maintain the desired temperature. If it is desired to operate the fan in summer, a hand switch may be inserted across the control circuit of the fan motor.



Typical application of control

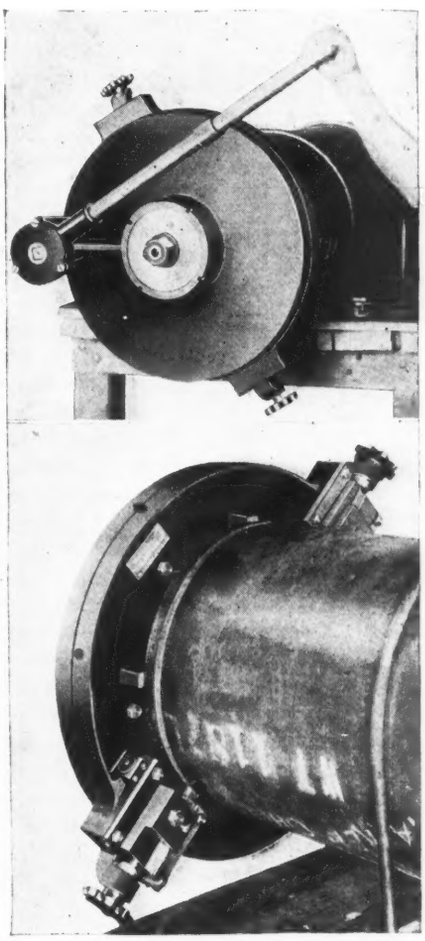
The control is especially suitable for application to existing installation, as it can be placed on the side of heater casing adjacent to the motor circuit, obviating the need for additional wiring. A 2 in. in diameter hole in the side of the heater casing, as at *D*, must be cut to permit the free flow of air at room temperatures across the thermostatic element.

Grooving Tool for Clamp-Type Pipe-Line Joints

A TYPE OF PIPE JOINT designated the "Victaulic," designed to take the place of the ordinary flanged and screwed coupling or bell-and-spigot joint, is now used extensively on oil pipe lines and large water-service lines. This joint, which is essentially two half housings forming a clamp and a rubber packing ring, requires a pipe having either grooved or beaded ends.

To facilitate installation in the field or on lines where the pipes have not been previously grooved, the grooving machine illustrated has been brought out by the Borden Company, Warren, Ohio.

It is made in five sizes, No. 12 for pipes from $\frac{1}{2}$ to 2 in.; No. 20 for pipes from 2 to $3\frac{1}{2}$ in.; No. 50 for pipes from 4 to 7 in.; No. 120 for pipes from 8 to 12 in.; No. 160 for pipes from 14 to 16 in. in diameter. The No. 12 tool can be hand-operated only, while the four larger sizes can be operated either by hand or by power. No. 12 machine follows the outside of the pipe



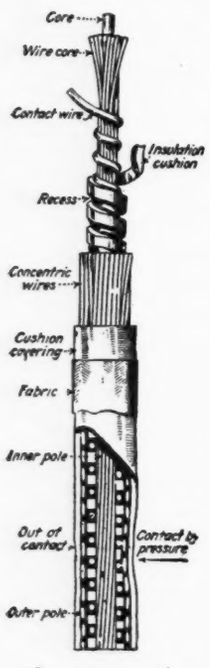
Grooving tool for Victaulic joints

and cuts a groove that conforms to the contour of the pipe, while in the larger machines a central spindle, on which the groove tool head is mounted, is locked in the center of the pipe. The grooving tools thus rotate around a true center and the groove cut is a true circle even though the end of the pipe may be out of round, which is frequently the case.

Although the four larger sizes can be operated by hand, a power drive is recommended by the manufacturer.

Contact Cable for Remote Control

A TYPE of waterproof cable which by pressure upon any point throughout its entire length serves as a switch or contact device is announced by the Bishop Wire & Cable Corporation, 420 Lexington Ave., New York City, N. Y.



Cut-away view of cable

The cable has a novel type of construction. Two conductors, inclosed by the outside insulation, are left bare, but are separated from each other by an "isolating cushion" of rubber. When pressure is applied this cushion yields and permits the outer conductor to contact with a wire which is always in contact with the inner conductor, thus closing the circuit. When pressure is relieved the isolating cushion returns the outer conductor to its normal position. The conductors are, therefore, not insulated but isolated.

Among the important uses to which the cable can be put in a power plant is for emergency control along a coal conveyor; for when used with a relay switch the cable becomes operative at the point of pressure, wherever the operator happens to be standing. This obviates the necessity of having to reach a push-button station before the conveyor can be stopped.

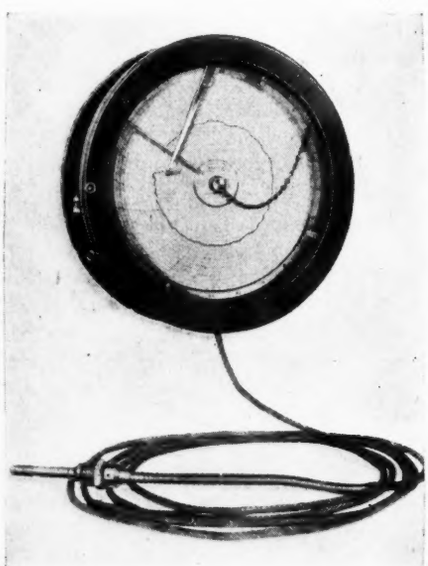
New Recording Thermometer

A NEW RECORDING THERMOMETER, designed for temperatures from minus 40 to plus 750 deg. F., is announced by the Moto Meter Gauge & Equipment Corporation of Long Island City, N. Y. It is designated Model 1000.

In design, the instrument consists of a dust-, fume- and moisture-proof housing which incloses the working parts. The element is comprised of a bulb, capillary tube and Bourdon tube, filled solidly with a special liquid that has an equal coefficient of expansion over the entire scale range of the instrument.

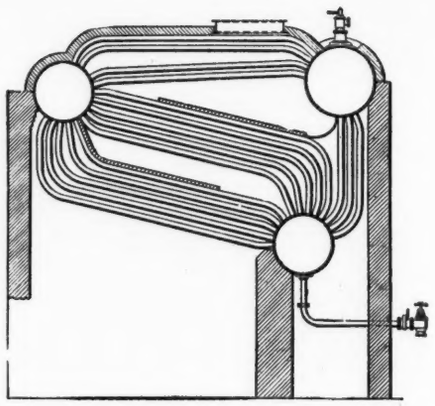
When the bulb is subjected to heat or cold, the liquid expands or contracts, and this action is transmitted through the capillary tubing to the Bourdon tube, causing the latter to wind or unwind and move a pen across the face of a chart actuated by a 24-hr. or a 7-day clock mechanism.

The ratio between the pressure of the liquid and the movement of the pen is 1 to 1, so that levers, gears and other small parts are eliminated. A compensating spring takes up any difference between the bulb and room temperature and automatically resets the pen at the point on the chart corresponding with the bulb temperature.



Instrument with bulb and capillary tube

Instruments are available with the flexible or capillary tubing in a variety of lengths to meet practically any installation requirement.



VM-type boiler with horizontal baffle

New Water-Tube Boiler Designed for Limited Space Conditions

DESIGNED especially for limited space conditions, particularly where the head room is low, the type VM boiler illustrated is now being put out by the Combustion Engineering Corporation, 200 Madison Ave., New York, N. Y., in a number of sizes and pressure ranges; from 1,595 sq.ft. to 4,464 sq.ft. of heating surface and 5 to 250 lb. working pressures, respectively.

Various setting arrangements are possible with this boiler to permit the use of the method of firing best suited to the application conditions and load requirements. The front drum is so located that it is not fully submerged, allowing some steam liberation to take place there. This feature is of particular value in producing dry steam, since that liberated in the front drum passes to the rear, or steam outlet drum, through dry tubes at the top of the gas pass. Two lower rows of tubes between these two drums carry water in circulation, giving an effect similar to that obtained in a cross-drum boiler.

Provision is also made in the design for the installation of a superheater, the essential change necessary being an arrangement of the baffles (usually a combination of horizontal and vertical baffles) to give the proper gas flow across the superheater.

In the pressure range from 160 to 250 lb., boilers with two sizes of drums, 36 and 42 in. I. D., are available. The tube diameter is $3\frac{1}{4}$ in. O. D., 11-gage tubes being used in the 160 and 180 lb. range and 10-gage in the pressures above this.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

THE JOHN FRITZ GOLD MEDAL *was formally presented to Dr. Ralph Modjeski, noted bridge designer and constructor, at the annual banquet of the American Society of Civil Engineers in the Hotel Commodore, New York City, on Jan. 15.*

* * *

LEGISLATION *authorizing the changing of the name of Boulder Dam to Hoover Dam, in honor of President Hoover, has been introduced in the Senate by Senator Smoot, of Utah. The bill has been referred to the Committee on Irrigation and Reclamation, and will be taken up early in the calendar.*

* * *

STEAM *for the new Empire State Tower, the tallest building in the world, now being erected on the site of the old Waldorf-Astoria Hotel in New York City, will be supplied by the New York Steam Corporation, according to a contract just signed by building officials and the corporation. The contract calls for the delivery of about 160,000,000 lb. of steam annually.*

* * *

A RECORD-BREAKING OUTPUT *for a single system was established by the Niagara Hudson Power Corporation with the production during 1929 of 6,875,133,336 kw.-hr. Hydro-electric ouput in 1929 remained practically the same as in 1928, while steam-electric output increased nearly 200 per cent.*

* * *

ONE MAN *was killed instantly and six others severely injured on Jan. 10 when a 200-ton elevator hoisting unit fell thirteen stories down a shaft in a partly constructed building in Philadelphia, Pa. The unit was being put into place on a supporting framework when it suddenly toppled over and fell.*

* * *

1929 SALES *of mechanical stokers, as reported to the Department of Commerce by the ten leading manufacturers in the industry, totaled 1,716 of 599,585 hp., as compared with 1,490 of 508,688 hp. in 1928.*

American Engineering Council Reports Growth of Activities in 1929

Carl Grunsky Elected President, Future Plans Outlined, and Progress Reported at Annual Meeting in Washington, Jan. 10-11

AT THE opening session of the annual meeting of the American Engineering Council, held at the Mayflower Hotel, Washington, Jan. 10-11, Carl E. Grunsky of San Francisco, past president of the American Society of Civil Engineers, was elected president. Mr. Grunsky, who will serve during 1930 and 1931, succeeds Arthur W. Berresford of New York, past president of the American Institute of Electrical Engineers.

Vice-presidents were chosen as follows: L. B. Stillwell, New York, American Institute of Electrical Engineers; Major Gardner S. Williams, Ann Arbor, Mich., Detroit Engineering Society; O. H. Koch, Dallas, Texas, Technical Club of Dallas; and L. P. Alford, New York, American Society of Mechanical Engineers. Dr. Harrison E. Howe of Washington, representing the American Institute of Chemical Engineers, was re-elected treasurer. Lawrence W. Wallace of Washington continues as executive secretary, a post he has occupied since the formation of the council as the public service body of the engineering profession under the presidency of Herbert Hoover in 1919.

Reports of officers and committees showed the council to be in a flourishing condition. Mr. Berresford, in an address as retiring president, pointed out that during the ten years of its existence the council had fulfilled the hopes of its founders, and was firmly established as the instrumentality through which the engineering societies of the nation may actively function in public affairs. A statement issued in behalf of Mr. Grunsky, who is returning from a trip around the world, called upon engineers to realize the obligation of public service which rests upon the profession.

"The American Engineering Council," Mr. Grunsky declared, "will contine, as in the past, not alone to participate in the study and solution of problems affecting the welfare and general progress of the nation, but also to stimulate individual and organized efforts to a better understanding of the relation of the individual engineer and of engineering organizations toward such problems, and to the public in general, all with the purpose of strengthening and broadening the nation's social and economic structure in the interest of progressively higher civilization."

The council acted upon numerous measures now pending in Congress, planned a program of study for 1930, announced the personnel of the new contingents from the member societies, reorganized its committee, and cleared the way for what promises to be the most active year in its history.

Notable among the accomplishments of 1929, it was pointed out, was the issuance of the report of the council's Committee on Street Traffic Signs, Signals, and Markings. This report, the recommendations of which are already being employed in practice in many of the states of the union as well as in foreign countries, has, it was stated, commanded world-wide influence. It has been accorded public recognition equal to that of the famous report of the Committee on the Elimination of Waste in Industry.

The Washington headquarters of the council has become an active and effective clearing house for the engineering societies in their relations with the federal government, in all branches of which the council's co-operation and counsel have the force of authority in the field of engineering.

N.E.L.A. Announces Prize Awards

Announcement of the 1929-1930 prize awards of the National Electric Light Association has just been made by the Prize Awards Committee. As in the past, these consist of the Doherty general prize, the H. M. Byllesby accounting prizes, the Martin J. Insull public relations prize, the James H. McGraw engineering prizes and the James E. Davidson commercial prizes. Cash awards ranging from $100 to $250 will be made to those submitting the best papers on the various subjects. Winners will be announced at the annual convention of the association, to be held this year in San Francisco, Calif., on June 16-20. For further information, address the secretary of the N.E.L.A., 420 Lexington Ave., New York City.

New York Bill Proposes Searching Study of St. Lawrence Power Development

IN RESPONSE to the growing demands of industrial leaders in New York State, the first step has been taken toward lifting the subject of hydro-electric development of the St. Lawrence River out of partisian politics with the introduction in the Legislature of a bill providing for a searching investigation of the whole question by a commission to be appointed by the Governor. The bill marks the breaking of a political deadlock on the water-power issue of more than ten years' duration, and it is hailed throughout the state as the forerunner of a constructive program of definite action.

Former Governor Alfred E. Smith and his successor, Franklin D. Roosevelt, see in the bill a victory for their policy of state ownership and operation of the St. Lawrence project. Commenting on the proposed act, Governor Roosevelt said, "The bill introduced last night is of far greater importance than merely the removal of this great subject from the field of temporary politics, for it represents a definite approval of what the majority of people in this state have been striving for regardless of party lines—a sincere effort on the part of the state to develop, through a state agency, the great electric power of the St. Lawrence River."

In a statement read before the Senate, Majority Leader John Knight outlined the salient features of the bill as follows:

"This bill provides that the Governor shall appoint a commission of his own choosing to investigate his plan for developing the St. Lawrence. The selection of the members of the commission is left entirely to the Governor, and not even the formal confirmation of the Senate is provided for in the bill. It affords the Governor an opportunity through the commission of presenting to the people of the state all the facts in relation to the development of power on the St. Lawrence necessary to arrive at a proper conclusion.

"Before inquiring into other plans for the development of the St. Lawrence, the commission, under this bill, would be required to investigate thoroughly the practicability and advisability of the governor's plan for public development. If the commission should determine after a careful inquiry that the Governor's proposal is feasible, it must so report to the Legislature and submit a comprehensive plan.

"The bill declares it to be the policy of the state that the right of the people to the power resources shall remain forever inalienable.

"The commission would be required to consult the Federal authorities and the Canadian authorities through the proper channels regarding the willingness of those interested parties to proceed with the undertaking. It would be under mandate to estimate the cost of the development and the probable price at which the power could be sold in the available markets, and to report on ways of financing the project. It would submit to the Legislature a form of contract for the sale of the power.

"The commission would be required to report not later than Jan. 15, 1931, and $200,000 is appropriated in the bill for expenses. Whatever plan is evolved would be submitted to the Legislature and would become effective only with the approval of the Legislature."

Michigan Engineers to Observe 50th Anniversary

In honor of the fiftieth anniversary of the Michigan Engineering Society, the Fourth Michigan Engineering Conference will be held this year on Jan. 30-31 at Ann Arbor, the city where the society was founded. Incorporating special features, the program will be a review of engineering progress during the past 50 years along the general theme of "The Engineers' Contribution to the Art of Living."

President Hoover will make a five-minute radio address from Washington during the course of the banquet on Friday evening, while Secretary of Commerce Robert P. Lamont will speak in person at the dinner on Thursday. Governor Fred W. Green, of Michigan, will address the group at luncheon on Friday, with Mortimer E. Cooley, dean emeritus of the University of Michigan, presiding.

Among the interesting papers to be presented are: "The Engineer as a Builder," by W. A. Starrett, president of the Starrett Corporation; "The Field of the Engineer in Finance," by Clarence E. Groesbeck, executive vice-president of the Electric Bond & Share Corporation; and "The Field of the Engineer in Government," by Frank C. Emerson, Governor of Wyoming.

Business Forecast

IN ITS ISSUE of Jan. 22, the *Business Week* will print the following forecast:

"There is fairly definite evidence of an upturn in business activity in the records for the first two weeks of January. Something has jiggled the business thermometer, and if we were heading this brief forecast as usual with the weather man's terms, we would have to call the outlook for the first time in many weeks: *slightly warmer.* Steel production has risen somewhat abruptly; building contract awards are distinctly larger; coal production is running high; non-bulk carloadings have made a fairly good first-week upturn; and business transactions by check outside the stock-trading cities shot up astonishingly for the first week of the year, higher than for any week in 1929, and 7% above last year at this time.

"It is, of course, too early to say that these few statistical swallows insure an early summer, and we are not yet ready to forecast the probable time when a sustained upward movement will begin. But sufficient evidence is now in to assert that general buying power was not so greatly hurt by the market crash as has been supposed, that the recession following the boom expansion of the first half of 1929 has probably gone as far as it will go, and that renewed buying activity is beginning to get under way."

New Oil Tankers to Have High-Pressure Turbines

High-pressure steam turbines will be installed in four new oil tankers now being built by the Federal Shipbuilding & Dry Dock Company and the Bethlehem Shipbuilding Corporation. These ships will be driven at 11 to 13 knots by De Laval compound turbines with double-reduction gears rated at 4,000 shaft horsepower and capable of developing a maximum of 4,400 hp. Steam will be supplied at 350 lb. gage from B & W boilers. It is claimed by the makers that marine steam turbines of this size and type, using high-pressure, high-temperature steam, regenerative feed-water heating, air heaters and economizers to improve boiler efficiency, are capable of developing one shaft horsepower on an oil consumption of from 0.6 to 0.7 lb. per hour, including steam used for all purposes on shipboard.

N. Y. Bill Would Regulate Investment Trusts

The first real attempt to regulate investment trusts in New York State is contained in a bill introduced in the Assembly Jan. 15 by Edward S. Moran, Jr. The bill recognizes that there is no such thing as an "investment trust" under the laws of New York State, all being chartered under the general corporation laws of the state, or if organized in another state or country, allowed to do business by registering in the office of the secretary of state, and sets up a technical description of the kind of corporation to be regulated.

Among other things it is provided in the bill, which goes into effect July 1, 1930, that the rules and regulations shall prohibit the purchase by any such corporation of stocks on a margin and the making of call loans. It prohibits the ownership of voting stock at the same time in more than one insurance corporation or public utility corporation. Also, a corporation may not acquire more than 50 per cent of the voting stock of any corporation without the permission of the bank superintendent.

Senate to Survey Power Commission Feud

The Senate Committee on Interstate Commerce is to make a survey of the Bonner-Russell-King feud in the Federal Power Commission establishment. Under the authority of the resolution empowering it to hold hearings with reference to the Couzens Federal Communications Commission bill it has called on members of the commission to supply it with copies of all opinions, and letters or memoranda having to do therewith, received by them from the chief counsel, assistant counsel, solicitor, and chief accountant of the commission. Secretary Bonner is directed to turn over to the committee all memoranda and letters sent by him to the foregoing in regard to opinions. The request grows out of controversies anent Secretary Bonner, Solicitor Russell and Chief Accountant King with relation to sundry acts of these officials in regard to applications for and granting of power licenses.

While the Senate committee awaits the requested material, the House Committee on Appropriations is looking into the same subject. Secretary Bonner has been before it and is to appear again.

It is stated that the Senate committee's call for the material does not indicate that hearings as to power have been advanced. Plans are to defer these until after all phases of the communications features of the Couzens bill have been covered.

Industrial Group Finances Work of A. S. A.

Announcement that the underwriting of the finances of the American Standards Association for a period of three years, to permit a total annual expenditure of $150,000 for the association's work, is now being completed, has just been made by William J. Serrill, president of the A.S.A. This fund permits an increase in the 1930 budget of $80,000 over the previous budget of the association and is expected to result in an expansion of national standardization work affecting practically all industries.

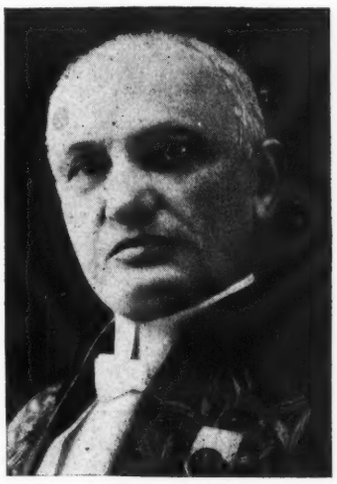
The fund is being underwritten by a large group of industrial organizations. It was arranged by a committee consisting of James A. Farrell, president of the United States Steel Corporation; Gerard Swope, president of the General Electric Company; George B. Cortelyou, president of the Consolidated Gas Company of New York; and F. A. Merrick, president of the Westinghouse Electric & Manufacturing Company.

Because of the rapid growth of the industrial standardization movement in this country, the underwriting was planned to permit immediate expansion of the work of providing authoritative national standards while permanent financing is under way. It is expected that this financing will be completed during the three-year period of the underwriting.

Auguste C. E. Rateau, Noted Turbine Inventor, Dies

Auguste C. E. Rateau, pioneer investigator in the steam-turbine and turbine-compressor fields, died in Paris on Jan. 14 at the age of 65. Widely known as the inventor of a mixed-pressure turbine bearing his name, Professor Rateau was one of the outstanding engineers of France.

At eighteen, two years under the age required by law, Professor Rateau was



Auguste C. E. Rateau

permitted to enter the Ecole Polytechnique of Paris by a special authorization of the French government. In his examinations after a full course he ranked first, a distinction he cherished throughout his life. Following this course, with post-graduate work at the Ecole Superieure des Mines, he was appointed professor of mathematics at the Ecole des Mines in St. Etienne at the age of 23.

While at St. Etienne, Professor Rateau worked out a theory of centrifugal fan design, which was later used commercially in the manufacture of over 100 different types of fans. At the same time he also made a complete study of the flow of steam through orifices. Calculations and tables derived from this study later came into virtually universal use. Following the completion of this study, he investigated the technical problems of steam turbine design, as a result of which he patented and marketed the mixed-pressure turbine bearing his name. This type of machine has been adopted partially or entirely by practically all turbine manufacturers in this country and abroad.

Professor Rateau was one of the first to realize the great savings to be obtained by the use of exhaust steam in low-pressure turbines. His many inventions in this field revolutionized power plant practice. He was also the first to develop the centrifugal turbine-compressor, which has found wide application in industrial and mining plants.

He was always active in the field of turbine propulsion of battleships, and during the World War he made many notable contributions to the study of ballistics, as well as inventions to increase the efficiency of airplanes. Recently he had aided Dr. Georges Claude in the development of a turbine using temperature differences between layers of the ocean.

A member of the Legion of Honor and laureate of the French Academy of Sciences, Professor Rateau was the recipient of many honors. He was the first Frenchman to be awarded an honorary degree of Doctor in Science by the University of Charlottenburg in Germany. He was a member of the British Institution of Mechanical Engineers and an honorary member of the American Society of Mechanical Engineers.

S. Z. de Ferranti, Inventor, Dies at Zurich

Dr. Sebastian Ziana de Ferranti, one of the pioneers in the electric power field, died at Zurich, Switzerland, on Jan. 13. He was 65 years of age.

Born in Liverpool, England, Dr. Ferranti was educated at Hempstead School and St. Augustine's College. Even as a small boy he showed a decided bent for mechanics, and while still a lad in school started the construction of his first dynamo. At 17 he obtained his first position, with Siemens Brothers, Ltd., where he made interesting experiments with arc and incandescent lamps, rotary field motors and generators, and observed the principle now employed in continuous-current meters. An outcome of these experiments was his invention of the unipolar mercury meter. In 1882, working with Sir William Thompson, he invented an alternator which created a sensation among electrical engineers.

When he was only 22, Dr. Ferranti began work on his idea of supplying London with electricity from a plant outside the city. By 1891 the scheme was perfected, and power was regularly transmitted to the city at the unusually high voltage for that time of 10,000. He was among the first to project the transmission of electricity at high voltages. The large Ferranti power plant at Hollinwood was started in 1895, and during the world war it was used in the manufacture of shells.

Long before the adoption of steam turbines, Dr. Ferranti predicted their use in large power stations. Later he turned his attention to turbine design. A proposition of his, which was published about 1912, involved the separation of the stator from the outer casing in order to relieve it of influences tending to produce unequal extension.

Recently Dr. Ferranti had been greatly interested in the development of radio and had devoted exhaustive study to the characteristics of audio-frequency transformers, which he brought to a high degree of efficiency. Among other societies, he was an honorary member of the American Institute of Electrical Engineers.

Men in Industry to Receive Awards

Industrialists as well as men in the shops and factories will hereafter be given public recognition for outstanding achievements in industry, under a plan formulated by the officials of MacDonald Brothers Engineering Laboratories, Inc., Boston, Mass. The plan provides that men in industry who make the most outstanding contribution to it each year will be awarded gold medals and substantial cash prizes by MacDonald Brothers. A committee composed of leading American industrialists will be appointed this year to determine the conditions of the awards.

H. E. MacDonald, vice-president and general manager of the laboratory organization, in announcing the plan of the company said it is about time that proper recognition is given to men in industry for their achievements. "Prizes are awarded each year to the persons making the outstanding contributions to the arts and some of the sciences, but rarely does one hear about men in industry being rewarded, at least while they live, for extraordinary achievement."

Boiler Inspectors Wanted by Government

The United States Civil Service Commission announces open competitive examinations for local and assistant inspectors of boilers to fill vacancies in the steamboat inspection service. Entrance salaries are $3,200 a year for local inspectors, and $2,900 a year for assistants. Higher-salaried positions are filled through promotion. Applications for examinations must be on file with the commission at Washington, D. C., not later than March 4. Full information may be obtained from the commission or from the secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city.

Bill Again Introduced for Hydraulic Laboratory

In order to make provision for fundamental research work pertaining to flood control and other engineering activities dealing with hydraulics, a bill has again been introduced by Senator Ransdell authorizing the establishment of a national hydraulic laboratory at the Bureau of Standards in Washington. Similar bills have been introduced in past sessions of Congress but have failed to receive the sanction of the Rivers and Harbors Committee of the House. The Senate, however, acted upon this legislation and passed a national hydraulic laboratory bill during the last regular session.

A degree of opposition from the Corps of Engineers was manifested against the bill on former occasions. The contention was raised that the army engineers have the authority to establish such a laboratory in cases where they believe it will be necessary to their work. Some amount of research work along this line was carried on by the army engineers in connection with the design of the Bonnet Carre spillway structure. It is believed, however, that the opposition will not be renewed by the present chief of engineers. President Hoover favors the legislation.

Under the terms of the bill a body to be known as the national hydraulic board is created. It will be composed of the Secretaries of Commerce, War, Interior, and Agriculture. Its function will be to determine from time to time the program of the projects to be undertaken. An appropriation of $350,000 is provided for the construction of a building to house the laboratory and for the installation of suitable equipment.

Coming Conventions

American Society of Mechanical Engineers. Fiftieth Anniversary Celebration at New York City, Hoboken, N. J., and Washington, D. C., April 5-9, 1930. Semi-Annual meeting at the Hotel Book-Cadillac, Detroit, Mich., June 9-12, 1930. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

American Welding Society. Annual meeting at society headquarters in New York City, April 22-25. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Canadian Electrical Association. Annual Convention at the Manoir Richelieu via the S.S. "St. Lawrence," June 11-13, 1930. Secretary, H. M. Lyster, 405 Power Building, Montreal, Quebec.

Engineering Institute of Canada. Annual meeting at the Chateau Laurier, Ottawa, Ont., Feb. 12-14, 1930. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

International Heating & Ventilating Exposition. Commercial Museum, Philadelphia, Pa., Jan. 27-31, 1930. Manager, C. F. Roth, Grand Central Palace, New York City.

International Congress for General Mechanics at Liege, Belgium, Aug. 31 to Sept. 7, 1930. For information address Alb. Schlag, 4 Place Saint-Lambert, Liege, Belgium.

National Electric Light Association. Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at Hotel Barlum, Detroit, Mich., the week of Feb. 10, 1930. Secretary, A. L. Jones, 9th St. and Mount Vernon Place, N. W., Washington, D. C.

New England States Association of the National Association of Power Engineers. Annual convention and exhibition of power machinery at the State Armory, Salem, Mass., June 19-20, 1930. Secretary, E. S. Daniels, 113½ Bridge St., Salem, Mass.

PERSONALS

C. J. JEFFERSON, for the past several years head of the Fuel Conservation Section of the Merchant Fleet Corporation, resigned on Dec. 31, 1929, to become associated with the Kennedy-Van Saun Manufacturing & Engineering Corporation. Mr. Jefferson has done pioneer work in the application of pulverized coal to the marine field. He had charge of the development work in connection with the United States Shipping Board vessels Mercer and West Alsek.

J. S. JENKS, for many years in charge of the operation of power stations for the West Penn Electric Company, has been made vice-president and chief engineer of that company. Associated with the West Penn organization since 1902, Mr. Jenks has had a wide experience in all branches of central station engineering.

CHARLES E. ABRAMS, for twenty years field and test engineer with Cluett Peabody & Company, has taken a position as consulting engineer with the Associated Laundries of America, Inc., at Syracuse, N. Y.

R. N. COKE, formerly electrical engineer for the Northwestern Power Company at Winnipeg, Man., has been appointed assistant general superintendent of the electrical department of the Montreal Light, Heat & Power Consolidated, Ltd., Montreal, Quebec.

A. S. LANGSDORF, acting dean of the Schools of Engineering and Architecture at Washington University, St. Louis, Mo., has been appointed chairman of the Industrial Research Committee of the St. Louis Section of the A.S.M.E.

BEAUDRY LEMAN, former hydro-electric engineer and now general manager of the Banque Canadienne-Nationale, has recently been elected president of the Canadian Bankers' Association. During his engineering career, Mr. Leman was identified with the development of many hydro-power projects in the province of Quebec.

C. E. PLUMMER has been made superintendent of power distribution of the Turlock (Calif.) Irrigation District to succeed R. W. Shoemaker, who resigned recently to accept a position in Rio de Janeiro with the Electric Bond & Share Company interests. L. H. Parker was appointed assistant engineer of the district.

J. B. HAYES has been appointed general manager of the Nova Scotia Light & Power Company, Ltd., at Halifax, to succeed the late James F. Lumsden. Mr. Hayes was at one time assistant to the president of the Virginia Electric & Power Company in Richmond.

Business Notes

General Electric Company received orders during 1929 amounting to $445,802,519, as compared with $348,848,512 for 1928, an increase of 28 per cent. Orders for the fourth quarter of 1929 totaled $108,398,049, compared with $88,162,049 for the same period of the previous year.

Worthington Pump & Machinery Corporation, New York City, announces that its interests in the California territory are now served through a local company, the Worthington Machinery Corporation of California, Ltd., with headquarters at Los Angeles and San Francisco. The new corporation has taken over the sales and engineering staff and warehouse facilities of the Worthington Company, Incorporated, in California, and is now handling all that territory. H. D. Cornell, formerly president of the Worthington Machinery Corporation of Oklahoma, is president of the new organization.

Riley Stoker Company, Worcester, Mass., announces that Harold G. Meissner is now associated with its New York office as sales engineer.

Square D Company, Detroit, Mich., announces that it has adopted the new thirteen-month calendar for its business operations. Beginning with the first of the year, all accounts, salaries and internal records of the company will be handled on the basis of a thirteen-period year, replacing the former method of calendar months.

Pacific Coast Steel Company, San Francisco, Calif., a subsidiary of the Bethlehem Steel Corporation, has acquired all properties and business of the Southern California Iron & Steel Company. In addition the Pacific corporation has taken over the entire Pacific Coast selling organization of the Bethlehem company, and will sell not only the products of the newly acquired western plants, but also a full line of iron and steel products manufactured at the eastern mills of Bethlehem.

Anaconda Wire & Cable Company of California announces the removal of its San Francisco office and warehouse to 360 Ninth St.

Sargent & Lundy, Inc., announce the removal of their offices from 1412 Edison Building, 72 West Adams St., to 20 North Wacker Drive, Chicago, Ill.

Morton Vacuum Breaker Company, Canton, Mass., has appointed Charles C. Phelps as its New York representative and district engineer, with offices at 11 Park Place, New York City.

With the Society Sections

A.S.M.E., Anthracite-Lehigh Section. Dinner and meeting at the Hotel Americus, Allentown, Pa., Jan. 21, at 6:30 p.m. Subject: "Economical Generation and Distribution of Power," by W. A. Shoudy, consulting engineer, New York, and associate professor of mechanical engineering at Columbia University.

A.S.M.E., Metropolitan Section. Meeting in Room 502, Engineering Societies Building, Jan. 21, at 8 p.m. Subject: "The Recovery of Dust from Pulverized-Coal-Fired Stacks," by N. W. Sulzer, Eastern district representative, Research Corporation.

A.S.M.E., Philadelphia Section. Meeting at the Bellevue-Stratford Hotel, Jan. 28, at 8 p.m. Subject: "The Pioneer High-Pressure Industrial Plant of America," by W. E. S. Dyer, consulting engineer, Philadelphia. At this meeting descriptive data on the Philip Carey 1,840-lb. pressure plant, using reciprocating engines, will be presented.

Engineering Societies of Boston. Annual dinner and gala entertainment will be given at the Copley Plaza Hotel on Feb. 12.

Trade Catalogs

Clutches—A 12-page booklet describing and illustrating the construction and applications of the Pulvis clutch has recently been issued by Aktiebolaget Pulvis, of Stockholm, Sweden, who is represented in this country at the present time by Nils Wallenius, 114 East 52nd St., New York City. Copies of the bulletin may be obtained from the latter.

Metals—Copper's rôle in meeting the increased demand for machinery and for manufacturing materials resulting from the application of power to industry is described in a special issue of the bulletin of the Copper & Brass Research Association, 25 Broadway, New York City.

Separators—A large variety of separators for removing water, oil and solids from currents of live or exhaust steam and from air or other gases, are described in a 92-page illustrated bulletin No. 671, published by the Cochrane Corporation, 17th St. Bel. Allegheny Ave., Philadelphia, Pa. Numerous tables, diagrams and layouts are included in this publication.

Boilers — Three 800,000-lb. steam generating units recently installed in the new extension of the East River Station of the New York Edison Company are described in an attractively illustrated pamphlet of the Combustion Engineering Corporation, 200 Madison Ave., New York City, entitled, "The Largest Steam Generating Units in the World."

Waste Heat—Griscom-Russell Company, 285 Madison Ave., New York City, has recently published a bulletin (Form 463) on the recovery of waste heat from liquids and gases in industrial plants. The booklet contains a full description of the apparatus used, including diagrams of typical layouts, and gives examples of the results being obtained from various installations.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.25 @ $2.50
Kanawha	Columbus	1.30 @ 1.60
Smokeless	Cincinnati	2.00 @ 2.25
Smokeless	Chicago	2.00 @ 2.25
S. E. Kentucky	Chicago	1.30 @ 1.60
Steam	Pittsburgh	1.50 @ 1.75
Gas Slack	Pittsburgh	1.00 @ 1.20
Big Seam	Birmingham	1.25 @ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.00
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Jan. 16, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Jan. 8, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.695 per bbl., or 42 gal.; 26@28 deg., $1.745 per bbl.; 28@30 deg., $1.795 per bbl.; 30@32 deg., $1.845 per bbl.; 32@36 deg., gas oil, 4.651c. per gal.; 37@40 deg., distillate, 5.73c. per gal.

Pittsburgh—Jan. 7, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.25c. per gal.

Philadelphia—Jan. 7, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Jan. 14, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Jan. 7, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., $1.02½@$1.07½ per bbl.; 30@32 deg., $1.30@$1.35 per bbl.

Boston—Jan. 13, tank-car lots, f.o.b., 12@14 deg., Baumé, $1.05 per bbl.; 30@32 deg., 5c. per gal.

Dallas—Jan. 11, f.o.b. local refinery 26@30 deg., $1.35 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Lodi—N. Eckhart Engr., Bureau of Engineering, City Hall, San Francisco, submitted estimates for the construction of a power house on the Mokelumne River; headworks and track works, $15,719, power house and penstocks, $73,620, crane, $5,000, hydraulic installation, $65,810, generators and switchboards, $67,297, transformers and high tension switches, $18,654, auxiliary and miscellaneous equipment $5,000, transmission and phone lines, $69,625, transformers and stations, $20,832, dam $98,185, engineering and overhead, $68,142, etc. Total estimated cost $522,425.

Calif., Los Angeles—Los Angeles Gas & Electric Corp., 810 South Flower St., is having plans prepared for the construction of a 2 story, 50 x 100 ft. sub-station on 78th St. Private plans.

Calif., Los Angeles—Spring Street Realty Co., H. J. Bauer, Pres., California Bank Bldg., awarded contract for the construction of a 12 story bank and office building at 625-29 Spring St., to P. J. Walker, W. M. Garland Bldg. Estimated cost $1,000,000. Steam heating system, elevators, etc., will be installed.

Calif., San Diego—San Diego State Teachers College, awarded contract for the construction of a training school building, power house, etc. to H. Mayson, Long Beach. $137,645.

Calif., San Francisco—Treasury Department, Office of J. A. Wetmore, Acting Supervising Architect, Washington, D. C., will receive bids until Feb. 25, for the construction of a group of buildings including boiler house, laundry, etc. at U. S. Marine Hospital here.

Calif., San Juan Capistrano—San Juan-Orange County Water District No. 4, plans an election to vote $45,000 bonds for waterworks improvements including drilling of well, installation of pumps, etc.

Conn., Hartford—House of the Good Shepard, 170 Sisson St., is having plans prepared for the construction of a group of buildings including power house, etc. Estimated cost $200,000. Gander, Gander & Gander, 17 Steuben St., Albany, N. Y., are architects.

Conn., New Haven—Shell Eastern Petroleum Products, Inc., 42 Church St., awarded contract for a 15 x 20 ft. boiler house, garage, etc. to C. W. Murdock, Inc., 505 Grand Ave. Estimated cost $50,000.

Conn., New London—Southern New England Ice Co., 75 Howard St., awarded contract for the construction of an ice manufacturing plant to Bartlett-Brainard Co., 252 Asylum St., Hartford. Estimated cost $75,000.

Ill., Chicago—A. S. Alschuler, Inc., 28 East Jackson Blvd., Archts., will receive bids about Feb. 1 for the construction of a 13 story stores building at State St. and Jackson Blvd., for M. L. Rothschild, State St. and Jackson Blvd. Estimated cost $1,500,000.

Ky., Ashland—City voted $2,000,000 bonds for extensions and improvements to waterworks including 1,000,000 gal. filtration plant, pump, etc.

La., Shreveport—City voted $500,000 bonds for waterworks improvements including filtration plant, pumps, etc. J. N. Chester, Clark Bldg., Pittsburgh, Pa., is engineer.

Minn., Fairmont — City plans remodeling municipal electric light and power plant. Estimated cost $400,000. C. Foster, 512 Sallwood Bldg., Duluth, is consulting engineer.

Minn., Minneapolis—Northwestern Bell Telephone Co., 607 3rd Ave. S., plans the construction of a 27 story telephone exchange and office building including steam heating system, etc. Estimated cost $2,500,000. Hewitt & Brown, 1200 Second Ave. S., are architects.

Mo., Bismarck — City awarded contract for waterworks improvements including pump house, 250 g.p.m. motor driven pump, 250 g.p.m. gas engine driven pump, 150 g.p.m. deep well pump, tank on tower, etc., to J. O'Neal Construction Co. $43,000.

Mo., St. Louis — Washington University, School of Medicine, c/o G. R. Throop, Chancellor, awarded contract for the construction of a 50 x 160 ft. power house at 500 South Euclid Ave. to Baumes-McDevitt Co., 1955 Railway Exchange Bldg. Estimated cost $150,000.

Neb., Lincoln—City, F. H. Berg, Clk., City Hall, awarded contract for two 500 hp. water tube boilers complete with superheaters, soot blowers, feed water regulators, etc. to Murray Iron Works Co., Burlington, Ia., two chain grate stokers to Combustion Engineering Corp., 461 Bd. of Trade Bldg., Kansas City, Mo., economizer to Green Fuel Economizer Co., Beacon, N. Y. $14,000, and two replacement stokers to Illinois Stoker Co., Alton, Ill.

N. Y., South Nyack (mail Nyack)—Nyack Development Corp., c/o B. F. McGuire, 416 Cedar Lane, Teaneck, Archt., is having plans prepared for the construction of a 6 story hotel including steam heating system, elevators, etc. on River Rd. Estimated cost $1,000,000.

O., Ashtabula—Cleveland Electric Illuminating Co., W. H. Hartman, Purch. Agt., Illuminating Bldg., Cleveland, awarded contract for superstructure of a 250 x 325 ft. power plant here to Hunkin-Conkey Construction Co., Newman-Stern Bldg., Cleveland. Estimated cost $4,000,000.

Pa., Ellwood City — Boro of Ellwood, L. Monroe, Mgr., Boro Bldg., plans the construction of an electric power plant in Lawrence County. Engineer not selected.

R. I., Woonsocket—National Service Co., 150 Congress St., Boston, Mass., plans the construction of an ice plant here. Private plans.

Tex., Big Spring—Texas and Pacific Ry. Co., Dallas, awarded contract for a railway division terminal including round house, machine and blacksmith shops, power house, boiler house, etc. to R. E. McKee, El Paso. $240,000.

Tex., Galveston—Galveston Electric Co., 21st St. and Ave. I., plans improvements to system; principally new equipment for power stations, extension of transmission and distribution lines, etc. Estimated cost $150,000. Private plans.

Tex., Progresso—Hidalgo County Water Improvement Dist. No. 5, c/o H. V. Watts, Donna, voted $90,000 bonds for the construction of an irrigation project including pumping equipment, etc.

Utah, Moroni—City, voted $36,000 bonds for the construction of a two unit Diesel engine plant and distribution system. Engineer not selected.

Virginia — Shenandoah River Power Co., Weyers Cave, plans the construction of a hydro-electric power plant and dam 24 ft. high, to generate 2,000 hp. capacity on the south fork of the Shenandoah River between Elkton and Shenandoah City. Estimated cost $500,000.

Wash., Wenatchee — Puget Sound Power & Light Co., Stuart Bldg., Seattle, awarded contract for the design and construction of a hydro-electric plant and dam, 60 ft. high and 3,500 ft. long at Rock Island on the Columbia River near here; initial capacity 80,000, ultimate total capacity 200,000 hp. to Stone & Webster, Engineering Corp., 120 Broadway, New York, N. Y. Estimated cost approximately $15,000,000.

Wis., Milwaukee — R. B. Williamson, 405 Broadway, Archt., will receive bids until Feb. 1, for the construction of a 12 story office and stores building, etc. including steam heating system, elevators, etc. for G. Diller, 6th and State Sts.

Ont., Ragged Rapids—Hydro Electric Power Commission, 190 University Ave., Toronto, plans the construction of a hydro-electric power development on the Musquash River here. Plans include dam, power house, water turbines, governors, generators, transformers, switching equipment, transmission lines, etc. Estimated cost $1,500,000. F. A. Gaby, 190 University Ave., Toronto, is engineer.

Equipment Wanted

Generating Unit—Columbus, O.—Ohio State University, C. E. Steeb, Secy. Bd. of Trustees, plans to purchase a steam generating unit for power plant.

Generators—Brooklyn, N. Y.—Signal Supply Officer, 58th St. and First Ave., will receive bids until Feb. 4, for 34 motor generators, Signal Corp type, M. G. 8.

Motor—Gardner, Mass.—Box J., 75 hp., 220 v. 3 ph., 60 cycle a.c. motor.

Motors, etc.—San Francisco, Calif.—Posterad Engineering & Construction Co., 434 Russ Bldg., plans to purchase 30,000 10 in. dials for electric clocks, 30,000 1-30 hp., electric motors, and 30,000 reduction gears.

Pumping Equipment—Niantic, Conn.—State of Connecticut, plans to purchase pumping equipment and appurtenances for proposed pumping station.

Pumps, etc.—Belleville, Ont.—C. D. Campbell, City Hall, electric centrifugal pumps, etc. for proposed waterworks improvements.

Pumps, Compressors, etc.—Cleveland, O.—Austin Co., 16112 Euclid Ave., is receiving bids for pumps, compressors, etc. for year 1930.

Boiler and Stoker—College Point, N. Y.—Walter Kiddie Construction Co., 140 Cedar St., New York, Engrs. and Bldgs., are receiving bids for a 600 hp. boiler with stoker and auxiliary equipment for boiler plant addition to factory of I. B. Kleinert Rubber Co., College Point.

Industrial Projects

Conn., Bridgeport—General Electric Co., 1285 Boston Ave., awarded contract for the construction of a 4 story, 80 x 200 ft. cable plant to T. J. Pardy Construction Co., 1481 Seaview Ave. Estimated cost $200,000.

Ind., Fort Wayne—Capehart Phonograph Co., awarded contract for the construction of a 160 x 160 ft. factory to Rump-Kintz Co. Estimated cost $100,000.

Ind., Indianapolis—American Can Co., 1610 Merchants Bldg., awarded contract for a 5 story factory at 1936 South East St., to E. B. Ball, 1131 North Tacoma St. Estimated cost $41,000.

Ky., Louisville—W. P. Brown & Sons Lumber Co., 2531 South 4th St., will build a creosoting and wood preserving plant at Highland Park. Estimated cost $750,000. G. B. Shipley, Koppers Bldg., Pittsburgh, Pa., is architect and engineer. Work will be done by owners forces.

Mass., Lynn — J. S. Barnet & Sons, 128 Boston St., will soon award contract for a 1 story, 50 x 200 ft. addition to leather factory. Estimated cost $40,000. C. L. Betton, 31 Exchange St., is architect.

Mich., Royal Oak—Humphries Tractor Co., J. F. Relaford, 209 West 5th St., is having plans prepared for the construction of a 1 story, 60 x 200 ft. tractor plant at Grand Trunk Railway. Estimated cost $50,000. Private plants. Electric motors, etc. will be required.

Mo., Valley Park—Eagle Motor Truck Corp., J. P. Reis, Pres., 6156 Bartmer Ave., St. Louis, awarded contract for the construction of an auto truck factory including, 52 x 200 ft. building for parts department and 50 x 75 ft. paint shop at St. Louis Ave. and Second St. to E. H. DeLiniere Construction Co., 6522 Joseph St., St. Louis.

N. J., Belleville — Wallace & Tiernan Co., 11 Mill St., is having plans prepared for the construction of a chemical machinery plant on Mill St. Estimated cost $75,000. Fletcher-Thompson Inc., 542 Fairfield Ave., Bridgeport, Conn., is architect.

N. J., Carteret — Metal & Thermit Corp., Middlesex Ave., awarded contract for a 1 story, 80 x 120 ft. factory to Morrison & Sherman Inc., 223 Grove St., Elizabeth. Estimated cost $40,000.

N. J., High Bridge—W. Prym of America, Inc., 16 West 19th St., New York, N. Y., is having plans prepared for the construction of a 2 story plant for the manufacture of pins, clips, etc. here. Estimated cost $100,000. Architect not selected.

O., Cleveland—Chandler Products Corp., F. C. Chandler, Jr., Pres., Terminal Tower, manufacturers of automobile accessories, awarded contract for the construction of a 1 story, 90 x 200 ft. factory at Chardon Rd. to W. W. Emerson Co., 1836 Euclid Ave. Estimated cost $150,000.

Pa., Altoona — Dixon Motor Co., Inc., F. Dixon, Mrg., 2507 Beale Ave., is having plans prepared for the construction of a 1 and 2 story automobile truck manufacturing plant at 9th Ave. between 27th and 28th Sts. Estimated cost $75,000. Private plans.

Pa., Lititz—U. S. Envelope Co., R. J. Block, plans the construction of a paper mill. Estimated cost $250,000. J. H. Wickersham, Appel Bldg., Lancaster, is architect.

Pa., Neville Island — Vulcan Detinning Co., R. D. O'Neil, V. Pres., awarded contract for a 1 story, 105 x 402 ft. mill to The Austin Co., 493 Union Trust Bldg., Pittsburgh. Estimated cost $200,000. Entire project to be constructed over present plant, permitting work in plant to continue.

Pa., Swissvale — Wubco Battery Co., J. L. Rupp, Pres., Braddock Ave., will soon award contract for the construction of a battery plant at McCague and Irvine Sts. Estimated cost $200,000. Electric Auto Lite Co., Champlain and Mulberry Sts., Toledo, O., is engineer.

Tex., Abilene — Central Texas Iron Works, 2125 Webster Ave., Waco, plans the construction of an iron works plant here. Estimated cost $125,000. Private plans. Most of work to be done by owners forces.